

hp 5232A/5532A



HEWLETT-PACKARD COMPANY / OPERATING AND SERVICE MANUAL


5232A
5532A

**ELECTRONIC
COUNTER**

hp 5232A/5532A

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OPERATING AND SERVICE MANUAL

MODEL 5232A/5532A ELECTRONIC COUNTER

SERIALS PREFIXED: 306-

This manual applies directly to  Model 5232A/5532A Electronic Counters having serial number prefix 306. This manual with changes provided in Appendix I also applies to models having serial prefix numbers 245, 243, 236, 225, 223, 222, 210, and 209 (see Paragraph 1-4).

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Table 1-1. Specifications

MAXIMUM COUNTING RATE:

1.2 mc

REGISTRATION:

Number of Digits: 6

Model 5232A: neon column with display storage

Model 5532A: long-life Nixie with display storage

INPUT SENSITIVITY:

0.1 v rms sine wave

0.2 μ sec min pulse width

INPUT IMPEDANCE:

Approximately 1 megohm shunted by 50 pf

OVERLOAD:

Input voltage (rms) should not exceed sensitivity setting of attenuator by a factor of more than 20 for accurate indication, or by a factor of more than 50 before damage up to a maximum of 250 v peak.

OPERATING TEMPERATURE RANGE:

-20 to +65°C

TIME BASE FREQUENCY:

1 mc

TIME BASE STABILITY:

Aging Rate: 2 parts in 10^6 /week

As a Function of Temperature:

± 2 parts in 10^6 (+10°C to +50°C)

± 20 parts in 10^6 (-20°C to +65°C)

As a function of Line Voltage ($\pm 10\%$):

1 part in 10^7

TIME BASE EXTERNAL INPUT:

Sensitivity: 1 v rms into 500 Ω

Range: 100 cps to 1.2 mc, sine wave

TIME BASE OUTPUT:

1 mc; 3 v peak-to-peak at 1000 Ω

FREQUENCY MEASUREMENT:

Range: 2 cps to 1.2 mc

Accuracy: ± 1 count, \pm time base accuracy

Reads In: kc with positioned decimal point

Self-check: counts 100 kc

Gate Times: 10, 1, 0.1, 0.01 sec

PERIOD AND MULTIPLE PERIOD AVERAGE MEASUREMENT:

Range: 2 cps to 10 kc in single period; 2 cps to 100 kc in 10 period average, 2 cps to 1.2 mc in 100 period average and above.

Accuracy: ± 1 count \pm time base accuracy

$$\pm \frac{\text{trigger error}^*}{\text{periods averaged}}$$

Reads In: milliseconds or microseconds with positioned decimal point

Periods Averaged: 1, 10, 10^2 , 10^3 , 10^4 , 10^5
Self-Check: Frequency of 1 mc

RATIO AND MULTIPLE RATIO:

Range: f_1 : 100 cps to 1.2 mc, 1 v rms into 500 Ω
 f_2 : 2 cps to 1.2 mc

Reads: $(f_1/f_2) \times$ period multiplier

Accuracy: ± 1 count of f_1 , $\pm \frac{\text{trigger error}^* \text{ of } f_2}{\text{period multiplier}}$

BCD OUTPUT:

Impedance approximately 100K Ω

"1" State = -2 v

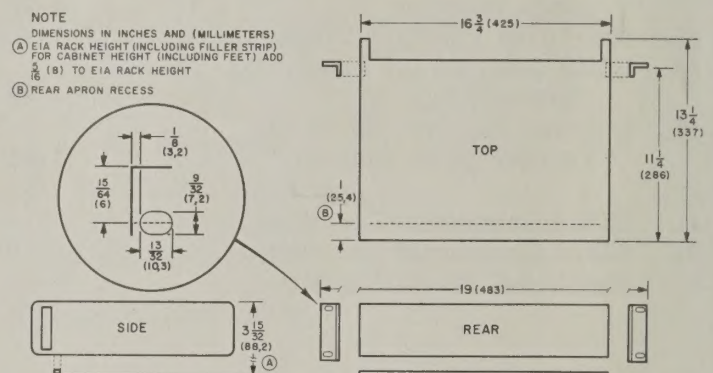
"0" State = -28 v

Reference Levels: Approx. -2.4 v, 350 Ω source impedance; and approx. -26.9 v, 1000 Ω source impedance

Print Command: Step from -29 v to -1 v, from 2700 Ω source in series with 1000 pf

Hold-Off Requirements: Chassis ground to ± 12 v max.

DIMENSIONS:



NET WEIGHT:

15 lb (7,0 kg)

POWER REQUIREMENTS:

115 or 230 volts $\pm 10\%$, 50 to 60 cps, 40 watts

ACCESSORIES PROVIDED:

AC-16K Cable, 4 ft (1220 mm) long, BNC connectors Circuit board extender, detachable power cord




* Trigger error for 0.1 v rms sinewave input is 0.3% for signals with 40 db signal-to-noise ratio. Trigger error decreases with increased signal amplitude and slope.

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. DESCRIPTION.

1-3. The  Model 5232A/5532A Electronic Counter measures frequencies from 2 cps to 1.2 Mc, period average up to 10^5 periods, and the ratio of two frequencies. The Model 5232A and the Model 5532A are similar: the Model 5232A displays measurements on a five-place neon column readout and the Model 5532A displays measurements on a five-place in-line Nixie® readout. The counter provides a four-line binary-coded-decimal output (1-2-2-4 code, 1-2-4-8 code optional at extra cost) for direct connection to the  Model 562A Digital Recorder, the  Model 580A/581A Digital to Analog Converter, or other data processing equipment.

1-4. IDENTIFICATION.

1-5. Hewlett-Packard uses a two-section, eight-digit serial number (on instrument rear panel) to identify instruments (000-00000). The first three digits are a serial prefix number, and the last five digits refer to a specific instrument. If the serial prefix on your instrument does not appear on the title page of this manual, there are differences between the manual and your instrument which are described in the appendix (serial prefix 245 and below) or in a change sheet included with the manual. If the change sheet is missing, the information can be supplied by your nearest Hewlett-Packard field office.

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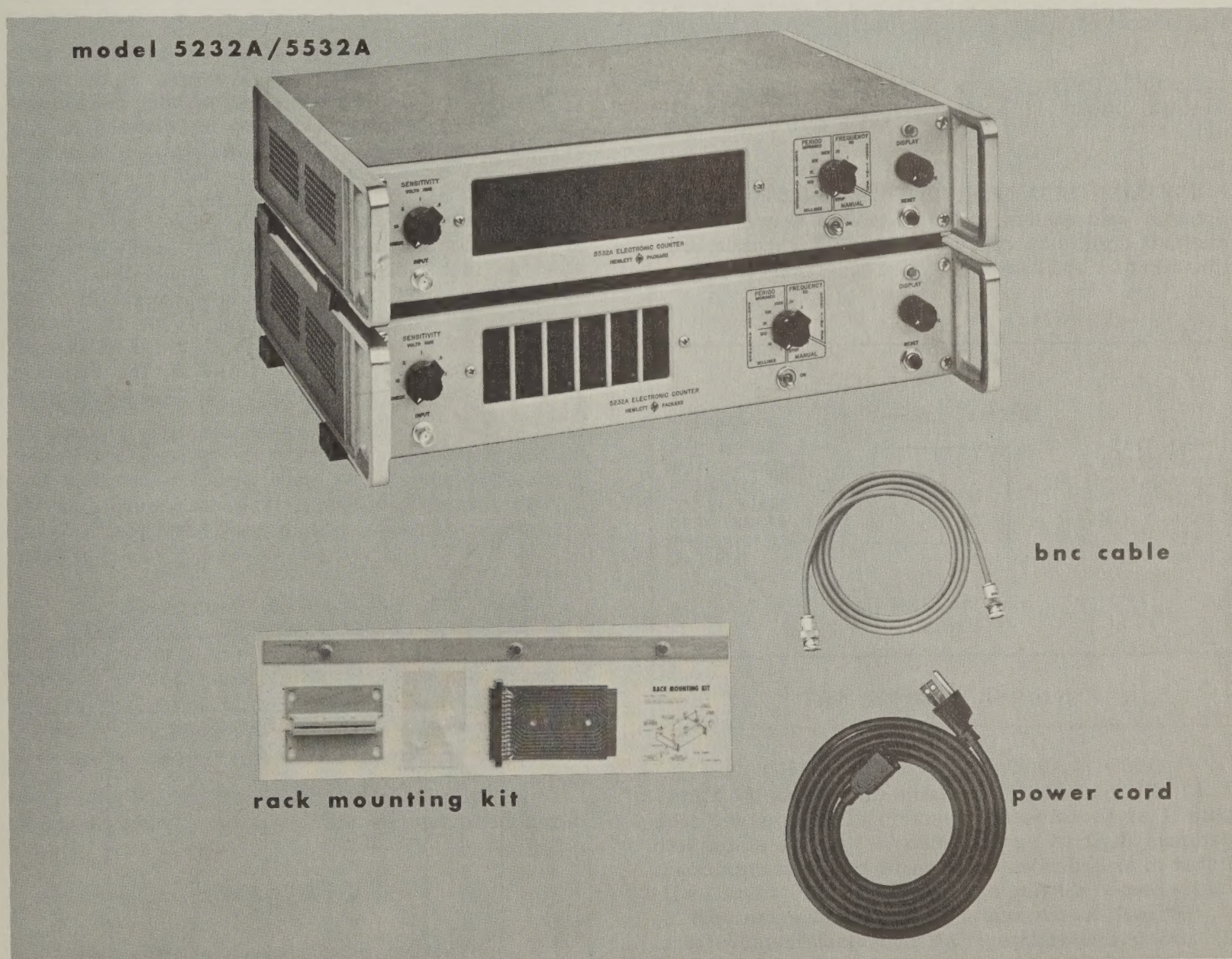


Figure 1-1. 5232A/5532A and Accessories

1-6. APPLICATIONS.

1-7. The Model 5232A/5532A can measure speed, rpm, acceleration, vibration, and other phenomena when they are converted to ac or pulses. It can simplify the production, test, adjustment, and calibration of low-frequency oscillators or pulse generators.

1-8. TERMINOLOGY.

1-9. The definitions of the following terms apply to those terms as they will be used throughout this manual.

a. BINARY. A bistable multivibrator (flip-flop) used to count or store binary information. The output of each binary is a "bit" or binary digit.

b. DECIMAL WEIGHT. Numerical value assigned to the output of each binary. In a 1224 code, decimal weights are assigned as follows: A binary, 1; B binary, 2; C binary, 2; D binary, 4.

c. "1" STATE. One transistor in binary conducting, output of binary indicates decimal weight present.

d. "0" STATE. Opposite transistor in binary conducting, output of binary indicates decimal weight absent.

e. 4-LINE BCD. Four-line binary-coded-decimal; decimal information coded in such a way that each decimal digit may be represented by a unique combination of 1 and 0 states of four binaries.

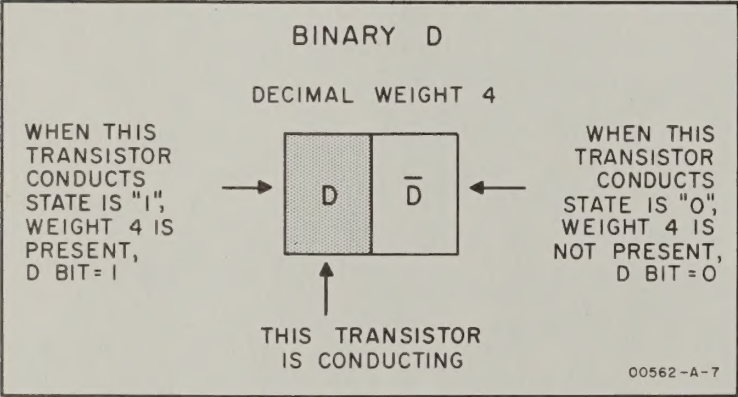


Figure 1-2. Binary Symbol

f. TRUTH TABLE. A table which lists the allowable 1 or 0 states of a system of binaries for each decimal digit to be represented. These states are listed in an order which presents the most significant digit first. Example: In a 1224 code, binaries D, C, B, and A are assigned decimal weights of 4, 2, 2, and 1 respectively. The decimal numeral 5 is represented by state 0111 and weights of 2, 2, and 1 are present. The allowable combination (0111) is listed in the truth table (table 1-2).

Table 1-2. Four-Line Code Truth Table

Digit	4-Line Code, 1-2-2-4 0 -, 1 +			
	D = 4	C = 2	B = 2	A = 1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	1	0
5	0	1	1	1
6	1	1	2	0
7	1	1	0	1
8	1	1	1	0
9	1	1	1	1

1-10. OPTIONAL BCD OUTPUT (OPTION 02).

1-11. The Model 5232A/5532A is available with 1-2-4-8 "1" state positive BCD output. In the Model 5232A/5532A, Option 02, decimal counter assemblies with 1-2-4-8 outputs have been substituted for the standard assemblies. These substitutions have been made: A4 through A8, 300 kc counter assemblies; stock no. 5212A-4A/5512A-4A replaced by stock no. 05212-6001/05512. A3, 5 Mc counter assemblies; stock no. 5232A-4C/5532A-4C replaced by stock no. 05232-6001/05532-6001. The Model 5232A/5532A, Option 02, is identical in all respects to the standard Model 5232A/5532A except for BCD code. Table 1-3 is a truth table for the 1-2-4-8 BCD code, and Figures IIA-1 through IIA-4 in the appendix provide schematic diagrams for the 1-2-4-8 decimal counter assemblies.

Table 1-3. 1-2-4-8 Code Truth Table

Digit	4-Line Code, 1-2-4-8 0 -, 1 +			
	D = 8	C = 4	B = 2	A = 1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

SECTION II INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information on unpacking, inspection, repacking, storage, and installation.

2-3. UNPACKING AND INSPECTION.

2-4. Inspect instrument for shipping damage as soon as it is unpacked. Check for broken knobs and connectors; inspect cabinet and panel surfaces for dents and scratches. A performance check is given in Paragraphs 5-11 thru 5-16. If instrument is damaged in any way or fails to operate properly, notify carrier immediately (see warranty sheet at rear of manual). For assistance of any kind, including help with instruments under warranty, contact your Hewlett-Packard field office.

2-5. STORAGE AND SHIPMENT.

2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment always use the best packaging methods available. Your Hewlett-Packard field office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are a few recommended packaging methods:

a. RUBBERIZED HAIR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq in. bursting test) with 2-inch rubberized hair pads placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit.

b. EXCELSIOR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb/sq in. bursting test) with a layer of excelsior about 6 inches thick packed firmly against all surfaces of the instrument.

2-7. ENVIRONMENT. Conditions during storage and shipment should normally be limited as follows:

- Maximum altitude 20,000 feet.
- Minimum temperature -40°F (-40°C).
- Maximum temperature 167°F (75°C).

2-8. RACK INSTALLATION.

2-9. The Model 5232A/5532A is ready for bench operation as shipped from the factory. Additional parts necessary for rack mounting are packaged with the instrument. To convert for rack installation, refer to Figure 2-1 and proceed as follows.

- Remove tilt stand.
- Remove feet (press the foot-release button, slide foot toward center of instrument, and lift off).
- Remove adhesive-backed trim strips at front end of sides.
- Attach flanges to front end of sides (larger corner-notch toward bottom of instrument).
- Attach filler strip along bottom edge of front panel. Instrument is now ready to mount in standard rack.

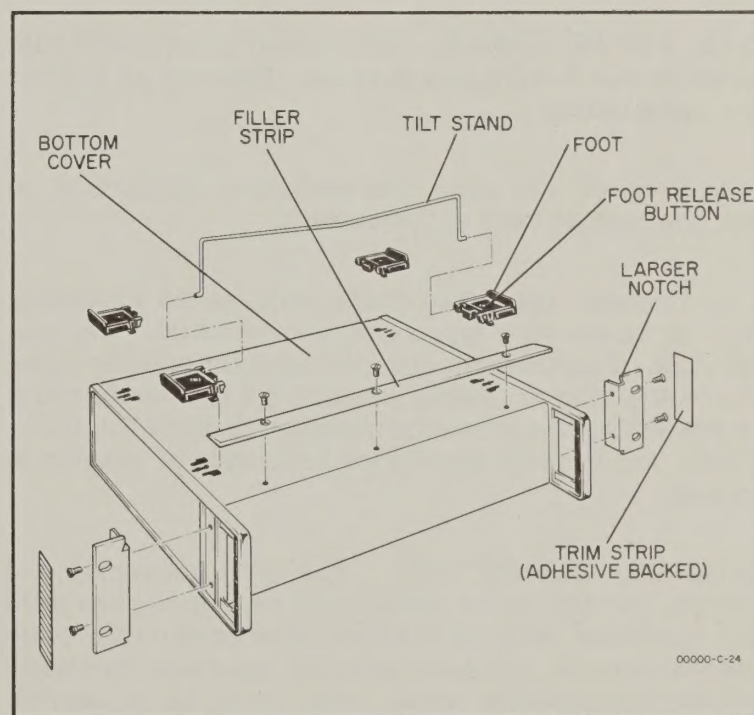


Figure 2-1. Conversion for Rack Mounting

CAUTION

Ambient temperature in rack during operation should not exceed a maximum of 140°F (60°C). Be sure instrument position in rack permits air circulation to intake on the rear of instrument and that nearby instruments do not discharge hot air near intake.

2-10. OPERATION FROM 115 OR 230 VOLTS.

2-11. The Model 5232A/5532A may be operated from either 115- or 230-volt ($\pm 10\%$) power lines. A slide switch on the rear panel permits quick conversion for operation from either voltage. Insert a narrow-blade screwdriver in the switch slot and slide the switch up for 115-volt operation ("115" marking exposed) or down for 230-volt operation ("230" marking exposed). The counter is supplied with fuse for 115-volt operation; be sure to replace this fuse for 230-volt operation; see table 2-1.

Note

Before connecting AC power to instrument be sure slide switch is properly positioned.

Table 2-1. 115/230 Volt Conversion

Conversion	115 volt	230 volt
Slide switch (S8)	Up ("115")	Down ("230")
AC LINE fuse (F1)	1.0 ampere fast-blow (ϕ p2110-0001)	.5 ampere fast-blow (ϕ p2110-0012)

2-12. REAR PANEL CONNECTIONS (figure 2-2).

2-13. POWER CABLE. The counter is equipped with a detachable 3-wire power cable. Proceed as follows for installation:

- a. Connect flat plug (three-socket connector) to AC line jack at rear of instrument.
- b. Connect plug (two-blade with round grounding pin) to three-wire (grounded) power outlet. Exposed portions of instrument are grounded through the round pin on the plug for safety; when only a two-blade outlet is available, use connector adapter (ϕ p Stock No. 1251-0048), and connect short wire from side of adapter to ground.

2-14. STD CONNECTOR. The STD connector and switch, located on the instrument rear panel are used for operation with an external time base or for ratio measurements. Connect external time base, or higher of two frequencies whose ratio is to be measured, to the STD connector, and move switch to the EXT position.

2-15. DIGITAL RECORDER. The 50-pin DIGITAL RECORDER jack (J4) on the rear panel permits connection to be made to the Hewlett-Packard Model 562A Digital Recorder through the 50-conductor input cable supplied as an option with Model 562A. Signals for other data processing equipment can also be taken from this jack. Mating connector is Amphenol No. 57-30500. Signals available and external signals required are given in table 2-2.

Table 2-2. Summary of Connections to Digital Recorder Jack

Function		J4 Pin No.
Digit	Weight	
(right end)	1	1
10^0 units	2	2
	2	26
	4	27
10^1 (tens)	1	3
	2	4
	2	28
10^2 (hundreds)	4	29
	1	5
	2	6
10^3 (thousands)	2	30
	4	29
10^4 (ten thousands)	1	7
	2	8
	2	32
10^5 (hundred thousands)	4	33
	1	9
	2	10
	2	34
	4	35
	1	11
	2	12
	2	36
	4	37
Inhibit signal input; about +12 volts supplied from external source to prevent reset; causes count to hold		22
Print command output; positive 28 volt pulse on -29 volt baseline signals that completed count is available for readout		23
Neg reference output; about -26 vdc indicates "0" level for BCD output		24
Pos reference output; about -2.4 vdc indicates "1" level for BCD output		25
Ground		50

2-16. COOLING.

2-17. The Model 5232A/5532A uses forced air cooling. The air intake and filter are located on the rear panel of the instrument. Inspect the filter regularly; clean the filter before it becomes dirty enough to restrict air flow (see para 5-3 for instructions on filter care).

Note

Do not apply coating compounds to the filter.

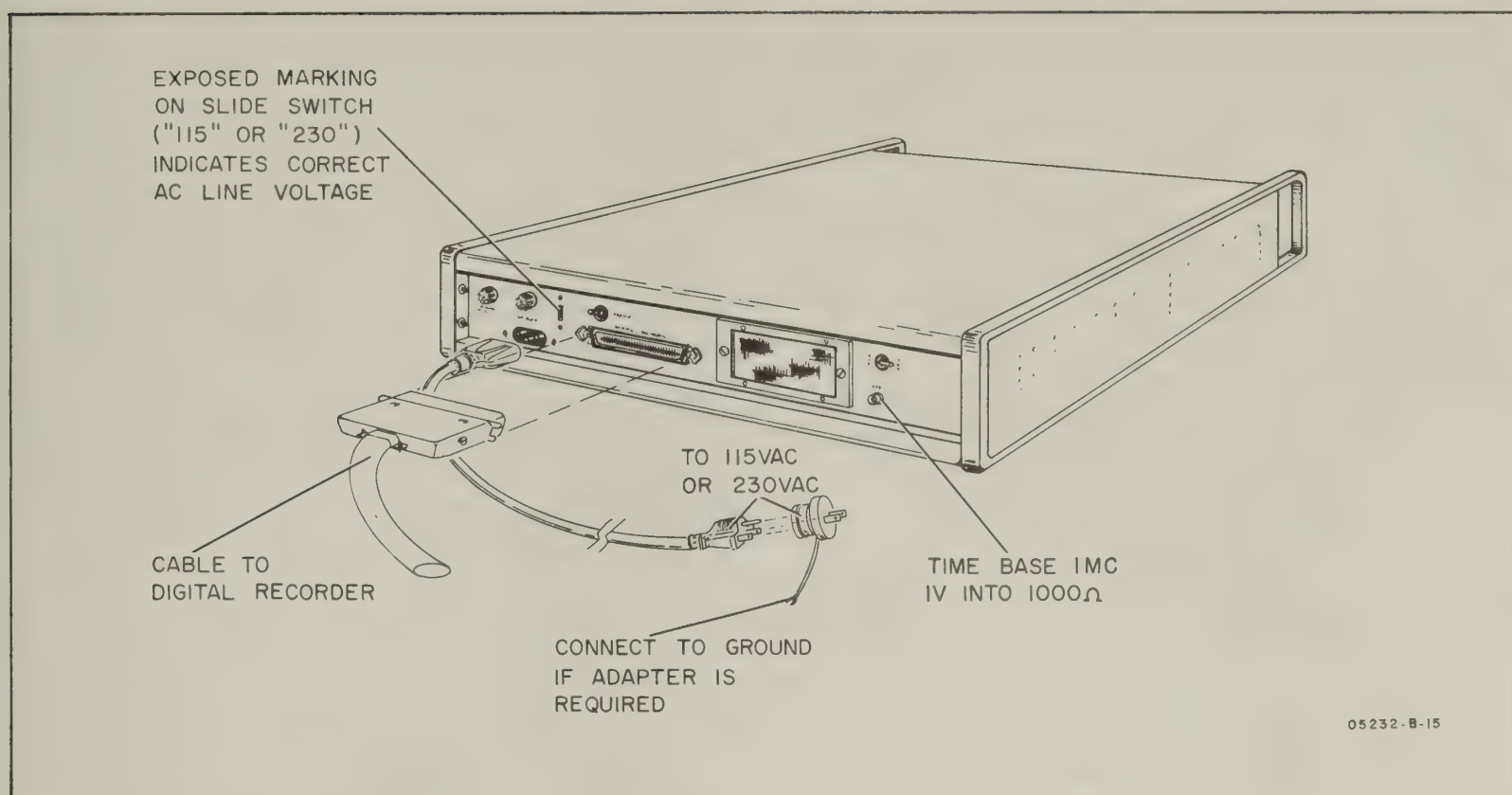


Figure 2-2. Rear Panel Connections

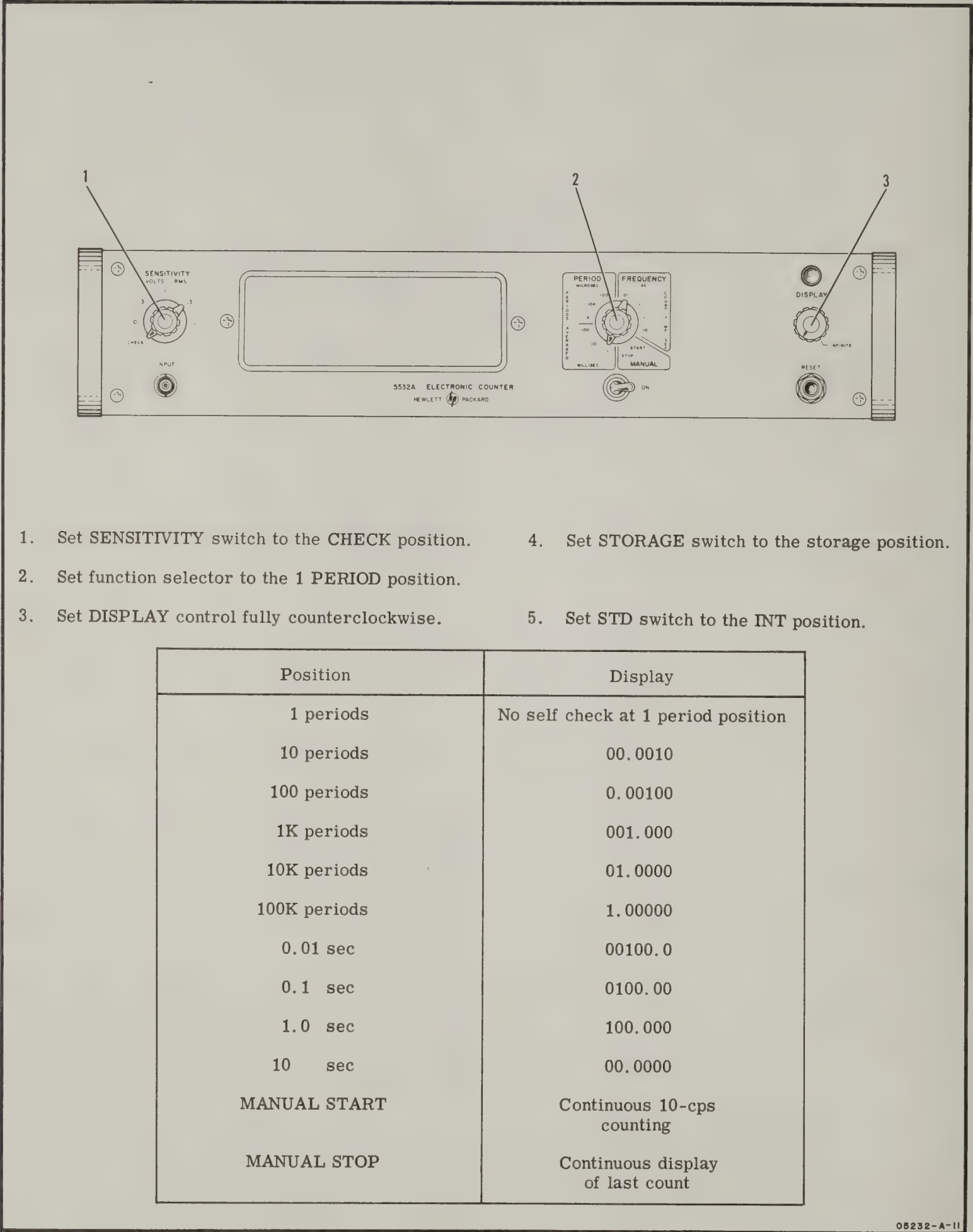


Figure 3-1. Self Check

SECTION III OPERATION

3-1. INTRODUCTION.

3-2. The Model 5232A/5532A measures frequency, period average, ratio of two frequencies, and total events. A function selector switch selects both measurement function and time base or multiplier. A DISPLAY control selects the sampling rate and a SENSITIVITY switch adjusts instrument sensitivity. Figures 3-1 and 3-3 through 3-6 provide step-by-step operating procedures for each measurement function. The number or numbers associated with each control indicate the step in which that control is used.

3-3. CONTROLS.

3-4. FUNCTION SELECTOR. The function selector is a twelve position switch used to select both measurement function and the time base (gate time) or multiplier desired for the measurement. See figure 3-7 for an explanation of panel markings.

3-5. SENSITIVITY CONTROL. The SENSITIVITY switch adjusts instrument sensitivity. With proper settings of the SENSITIVITY control the Model 5232A/5532A will operate with input signals between 0.1 v rms (sine wave) and 250 volts peak.

Note

Overload limits vary with settings of the SENSITIVITY switch. Input voltage (rms) should not exceed sensitivity setting of attenuator by a factor of more than 20 for accurate indication, or by a factor of more than 50 before damage up to a maximum of 250 v peak.

3-6. DISPLAY CONTROL. The DISPLAY control sets the period of time following a gate closure until the gate may be opened again. With the counter in the frequency mode, DISPLAY is adjustable from approximately 0.2 second as a minimum to at least 5 seconds as a maximum, and is independent of gate time. A control setting (INFINITE) is provided to hold the display indefinitely.

3-7. RESET PUSHBUTTON. The RESET pushbutton, when depressed, resets the display and internal count to zero. The counter, after reset, is ready to begin a new counting cycle.

3-8. EXTERNAL STD SWITCH. To use an external frequency standard (or the higher of two frequencies for ratio measurement), set the STD switch on the rear of the counter to EXT, and connect the external standard (higher frequency signal) to the BNC connector below the STD switch. When the STD switch is in the INT position, the 100 kc signal from the internal oscillator is available from the STD connector.

3-9. STORAGE SWITCH. The STORAGE switch on the rear panel provides a means of disabling the storage feature. The display storage feature provides a

continuous visual display while the instrument is totalizing a new count. Only if the new count differs from the previous count will the display change.

3-10. INTERPRETING DISPLAY.

3-11. Direct readout is provided in both PERIOD and FREQUENCY functions with measurement units indicated by the function selector and with decimal point automatically positioned. In the MANUAL function the display is read directly; the decimal point is not lighted. In the ratio function two methods may be used to interpret the display; 1) divide the displayed reading by the period multiplier indicated by the function selector; disregard decimal point. 2) If the function selector indicates a multiplier of 1, 10, or 100, move the decimal point two places to the right and read measurement from the display; if the indicated multiplier is 1K, 10K, or 100K, move the decimal point one place to the left and read ratio measurement from the display. Note that the only difference between ratio and period measurements is the use of an external frequency instead of the internal 100 kc oscillator.

3-12. ACCURACY.

3-13. FREQUENCY MEASUREMENTS. The basic counter accuracy is determined by two factors. One factor is the stability of the 1 mc crystal standard in the time base, which is 2 parts per million or .0002 percent per week. A second factor is the inherent error of ± 1 count present in all counters of this type. This error is due to phasing between the timing pulse that operates the electronic gate and the pulses that pass through the gate to the counters. The chart in figure 3-2 shows the errors to be expected for frequency or period measurements.

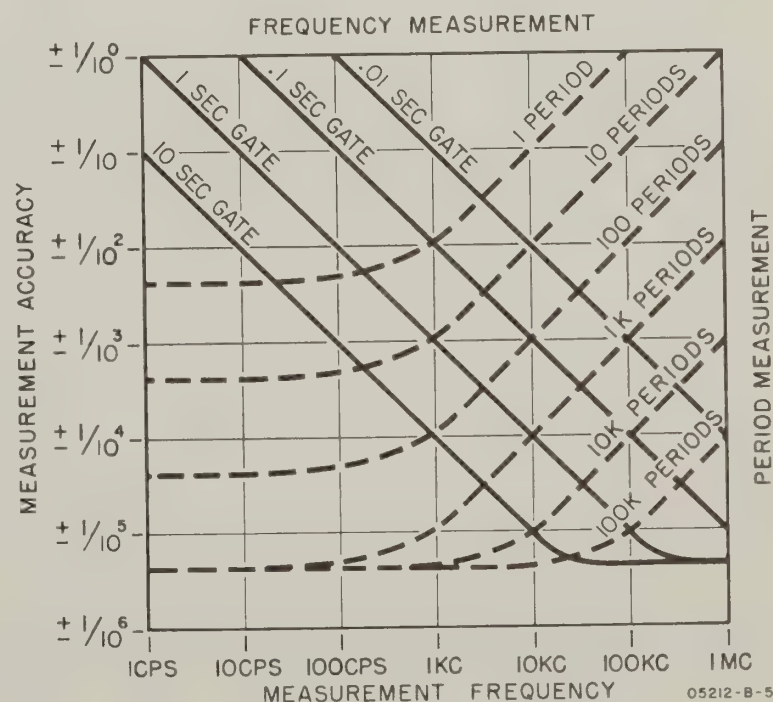
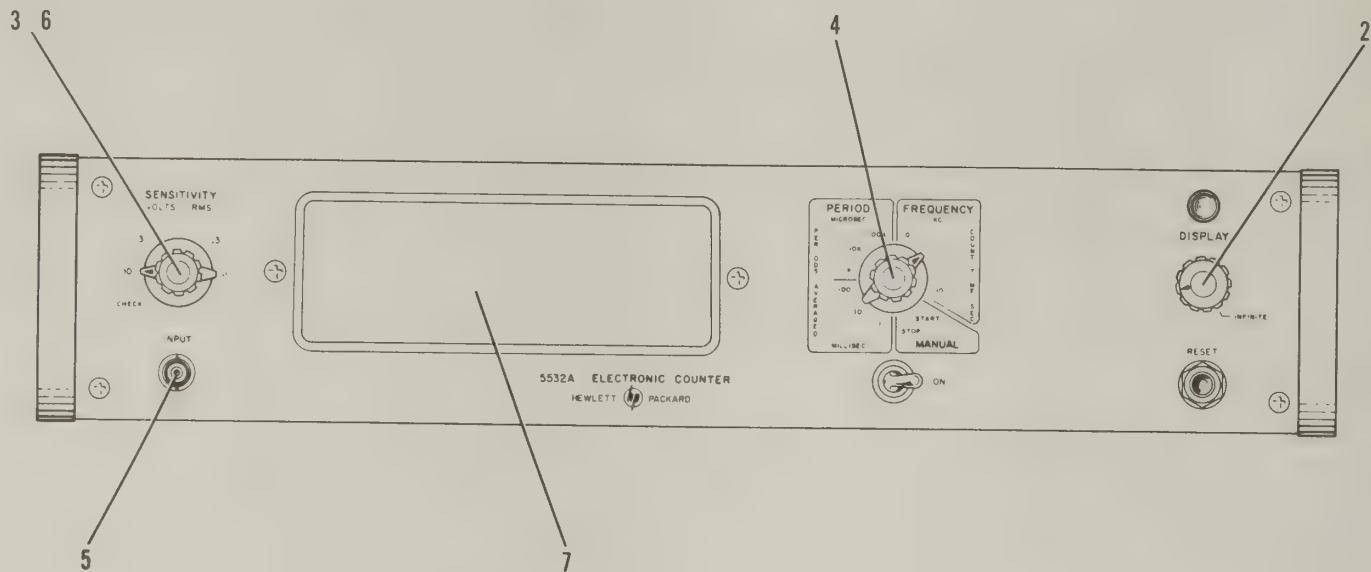


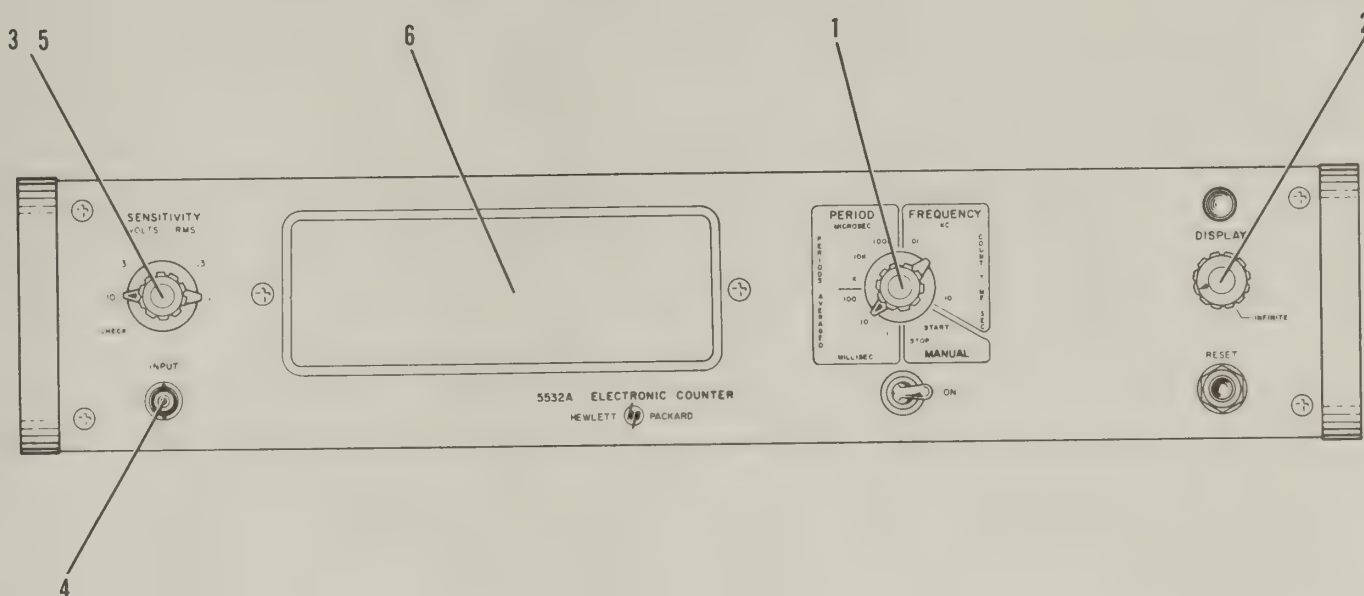
Figure 3-2. Measurement Accuracy



1. Set STD switch to the INT position.
2. Set DISPLAY for desired sample rate.
3. Set SENSITIVITY switch to the 10 VOLTS RMS position.
4. Set function selector switch to any FREQUENCY position.
5. Connect unknown frequency to INPUT jack.
6. Turn SENSITIVITY switch clockwise until consistent count is displayed.
7. Read frequency in kc. Decimal point is positioned automatically.

05232-A-12

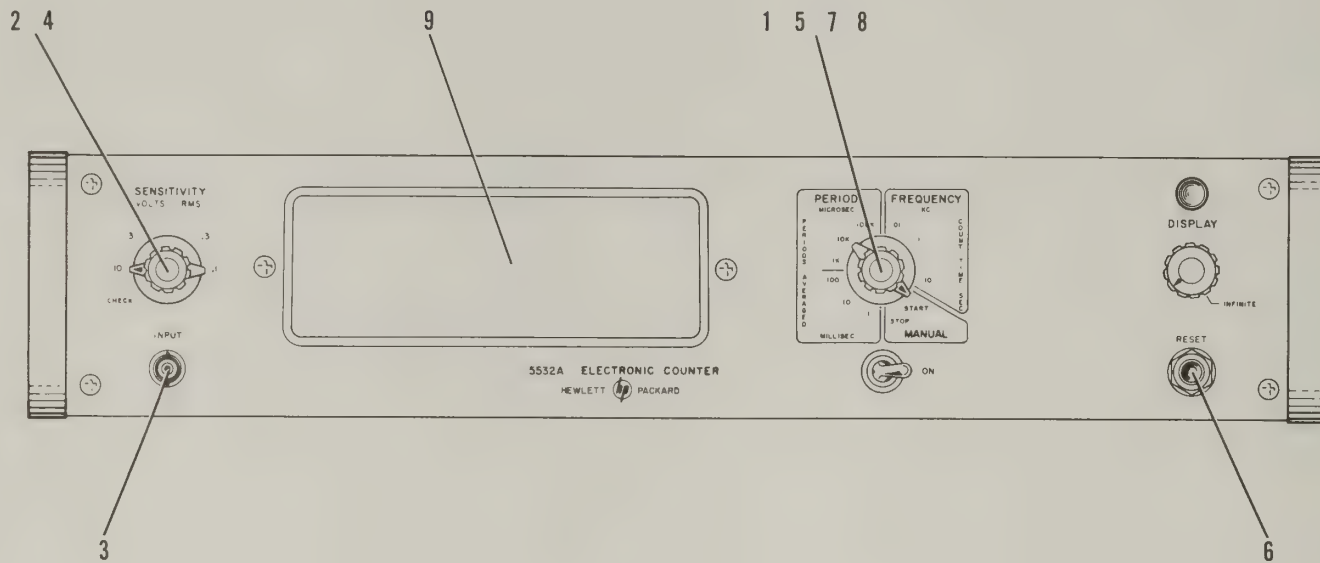
Figure 3-3. Frequency Measurements



1. Set function selector for number of periods to be averaged.
2. Set DISPLAY for desired sample rate.
3. Set SENSITIVITY switch to 10 VOLTS RMS position.
4. Connect signal to be measured to INPUT connector.
5. Turn SENSITIVITY switch clockwise until consistent count is displayed.
6. Read period in units indicated by function selector. Decimal point is automatically positioned.

05232-A-13

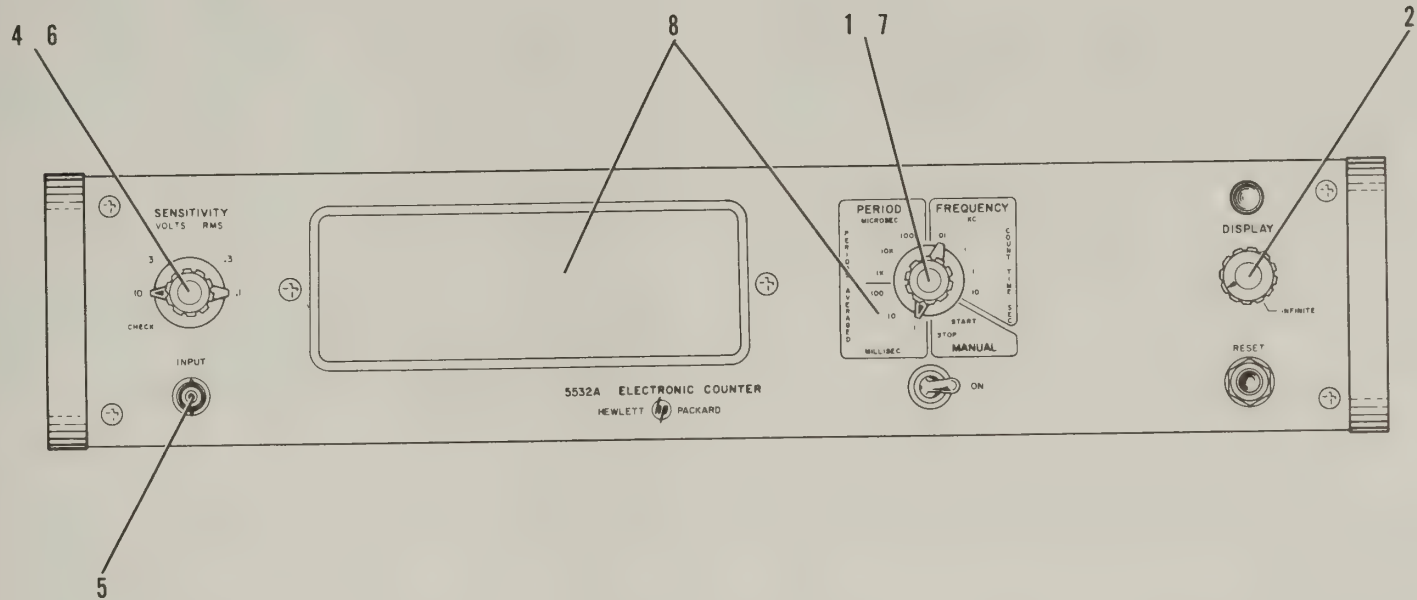
Figure 3-4. Period Measurement



1. Set function selector to MANUAL START.
2. Set SENSITIVITY switch to 10 VOLTS RMS position.
3. Connect signal to INPUT connector.
4. Turn SENSITIVITY switch until consistent count is displayed.
5. Set function selector to MANUAL STOP.
6. Press RESET to set display to zero.
7. To start count, set function selector to MANUAL START.
8. To end count, set function selector to MANUAL STOP.
9. Read total count.

05232-A-14

Figure 3-5. Totalizing Procedure



1. Set function selector to PERIODS AVERAGED, 1.
2. Set DISPLAY to desired sample rate.
3. Connect higher frequency (F1) to STD connector on rear panel and set STD switch to EXT.
4. Set SENSITIVITY switch to 10 VOLTS RMS position.
5. Connect lower frequency (F2) to INPUT connector.
6. Turn SENSITIVITY switch clockwise until consistent count is displayed.
7. Set function selector to PERIOD multiplier which gives desired resolution.
8. Divide display by PERIOD multiplier to obtain ratio $F1/F2$. Disregard decimal point (see paragraph 3-11).

05232-A-15

Figure 3-6. Ratio Measurement

3-14. Period measurements. There are three factors contributing to the accuracy of period measurements:

- a. The stability of the 1 mc standard which is $\pm .0002$ per cent. -
- b. The ambiguity of the ± 1 count.
- c. \pm trigger error (for one period, assuming Signal to noise ratio of 40 db, this trigger error is 0.3%). A general formula for finding the percentage error to be expected under various conditions is as follows:

$$A = 100 \left(\pm \frac{f_2}{nf_1} \pm \frac{e}{n} \pm E \right)$$

A = accuracy in %

f_1 = time base frequency counted (cps)

f_2 = frequency whose period is being measured (cps)

n = number of periods averaged

e = 3×10^{-3} (trigger error for one period, 40 db S/N)

E = time base accuracy (weekly maximum drift rate) E depends on the drift rate of the individual time base, absolute value of off-set at standardization and the time since standardization. A plot of this formula for the 5232A/5532A is shown in figure 3-2.

3-15. POSITIVE PULSES.

3-16. To measure positive pulses with the 5232A/5532A either invert them with a transformer or refer to section V, paragraph 5-24 and adjust input Schmitt Trigger until a consistent count is displayed.

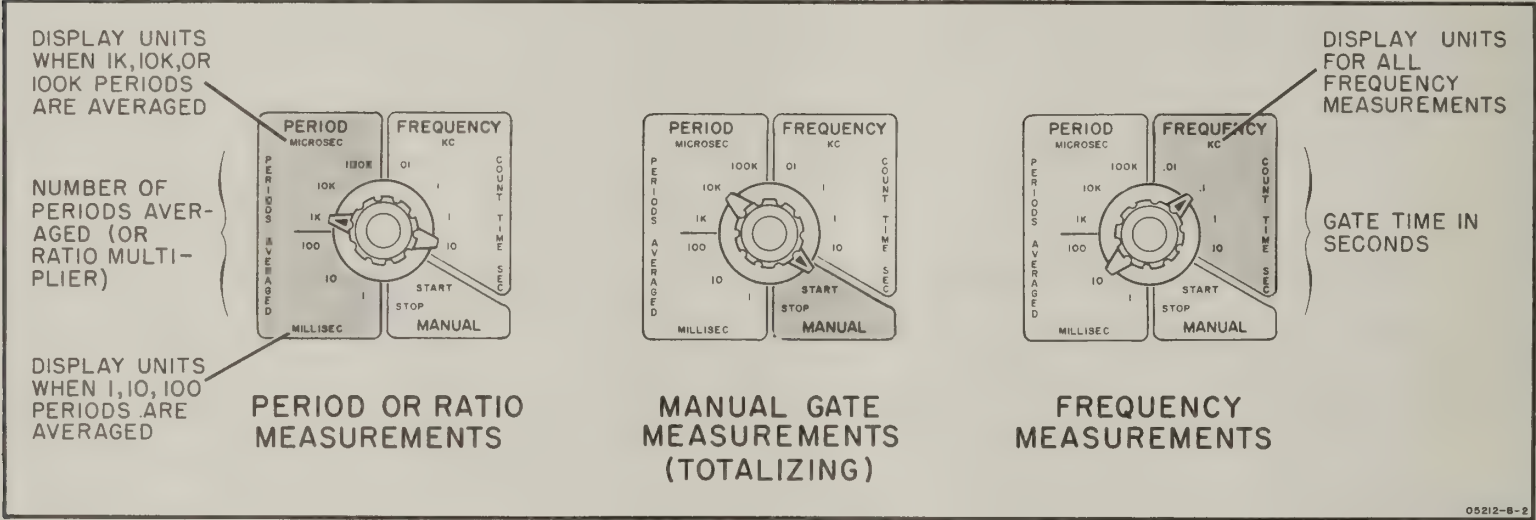


Figure 3-7. Panel Markings, Function Selector Switch

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section describes how the Model 5232A/5532A operates. Basic circuits used in the counter are described first (Paragraphs 4-3 through 4-22). Operation of decimal counters and decade dividers is thoroughly discussed in Paragraphs 4-23 through 4-33. A discussion of basic counter functions is given next (Paragraphs 4-34 through 4-40). Pulse timing circuits and overall operation of the entire counter are discussed in Paragraphs 4-41 through 4-46. At the end of the section each assembly is described in order of its assembly designation (A__) (Paragraphs 4-47 through 4-89).

4-3. THE DIODE.

4-4. GENERAL. Semiconductor diodes are used in signal-handling circuits and in power supply rectifier and regulator circuits.

4-5. THE "OR" GATE. Two or more diodes are sometimes used as an OR gate. The OR gate is a multiple-input circuit which requires only one input to produce an output. Figure 4-1A shows some OR gate configurations.

4-6. THE "AND" GATE. The AND gate or coincidence circuit is a multiple-input circuit which requires the presence of all input signals to produce an output. Figure 4-1B shows an AND gate configuration in which an input signal is passed only when a properly polarized control voltage is applied.

4-7. THE "INHIBIT" GATE. The signal normally passes through an INHIBIT gate; adding a second signal closes the gate and prevents the signal from going through. One of the most common forms of the INHIBIT gate is the series gate shown in Figure 4-1C. If the diode is biased off, the gate is closed, and pulses do not reach the decade divider or decimal counter; when the diode is biased on, the pulses go through the gate and reach the decade divider or decimal counter.

4-8. LIMITER OR CLIPPER. The limiter or clipper is a circuit which removes positive or negative peaks of waveforms. It can be used either as a waveform shaping circuit or as a protective device to prevent excessive voltages from reaching a sensitive circuit. Figure 4-1D shows a limiter which prevents the negative peak of a pulse from going more negative than about -0.6 volt. Note that for a conducting silicon diode the cathode voltage is about 0.6 to 0.8 volt more negative than the anode.

4-9. CLAMPER OR DC RESTORER. The clamper or DC restorer is a circuit which establishes either the positive or negative peak of a waveform at a particular DC reference voltage; in other words, it provides a definite baseline voltage for the waveform. Figure 4-1E shows a clamper which provides a baseline of about +20 volts for a negative pulse.

4-10. REGULATOR. A diode regulator uses either the constant reverse-bias breakdown voltage characteristic of a breakdown diode or the constant forward-bias voltage drop characteristic of a silicon diode. Power supply reference voltages are generally provided by breakdown diodes which maintain a constant voltage when supplied with a reverse-bias voltage greater than their specified breakdown voltage. Regulated voltages can also be provided by a forward-biased silicon diode which maintains a constant 0.6 to 0.8 volt drop. Figure 4-1F shows connections for both types of diodes.

4-11. THE TRANSISTOR.

4-12. GENERAL. Transistors are used throughout the counter in circuit configurations such as the amplifier, the flip-flop or binary, the trigger circuit, and the one-shot multivibrator. In the following paragraphs, basic transistor operation and a few basic transistor circuits are discussed. These paragraphs discuss the easily observed changes in currents and voltages in transistor circuits which help technicians locate circuit faults but do not attempt to describe how transistors work internally.

4-13. BIASING AND CONDUCTION. Vacuum tubes and transistors are functionally similar. In the tube a small grid-to-cathode voltage controls a larger plate-to-cathode current flow. In a transistor a small base-to-emitter current controls a large collector-to-emitter current. A comparison of basic vacuum tube NPN transistor, and PNP transistor operation is shown in Figure 4-2A; indicated current represents conventional flow of positive charges external to the transistor and is not intended to indicate flow of carriers inside the transistor structure. Notice that the effect of emitter-base-collector voltages is totally reversed between NPN and PNP transistors; circuits which are arranged for an NPN transistor usually function normally for a PNP transistor if supply voltages are reversed.

4-14. AMPLIFIERS. As with vacuum tubes, three basic amplifier types are available (Figure 4-2B). These amplifiers may be used alone or in combination to form complex circuits.

4-15. FLIP-FLOP. The flip-flop is a bi-stable two-transistor circuit in which one transistor conducts, holding the other cut off. Each input pulse causes a reversal of states; that is, the cut off transistor is turned on and the conducting transistor is cut off. In the flip-flop shown in Figure 4-3A, Q1 is initially conducting heavily; its collector voltage is only slightly negative; a near-zero voltage is supplied to the base of Q2 (junction of R27-28 divider). The voltage drop across R24 produces a sufficiently negative voltage at the emitter of Q2 to hold Q2 cut off. With Q2 cut off the R18-R19-R20 divider delivers a negative voltage to the base of Q1 to keep it conducting.

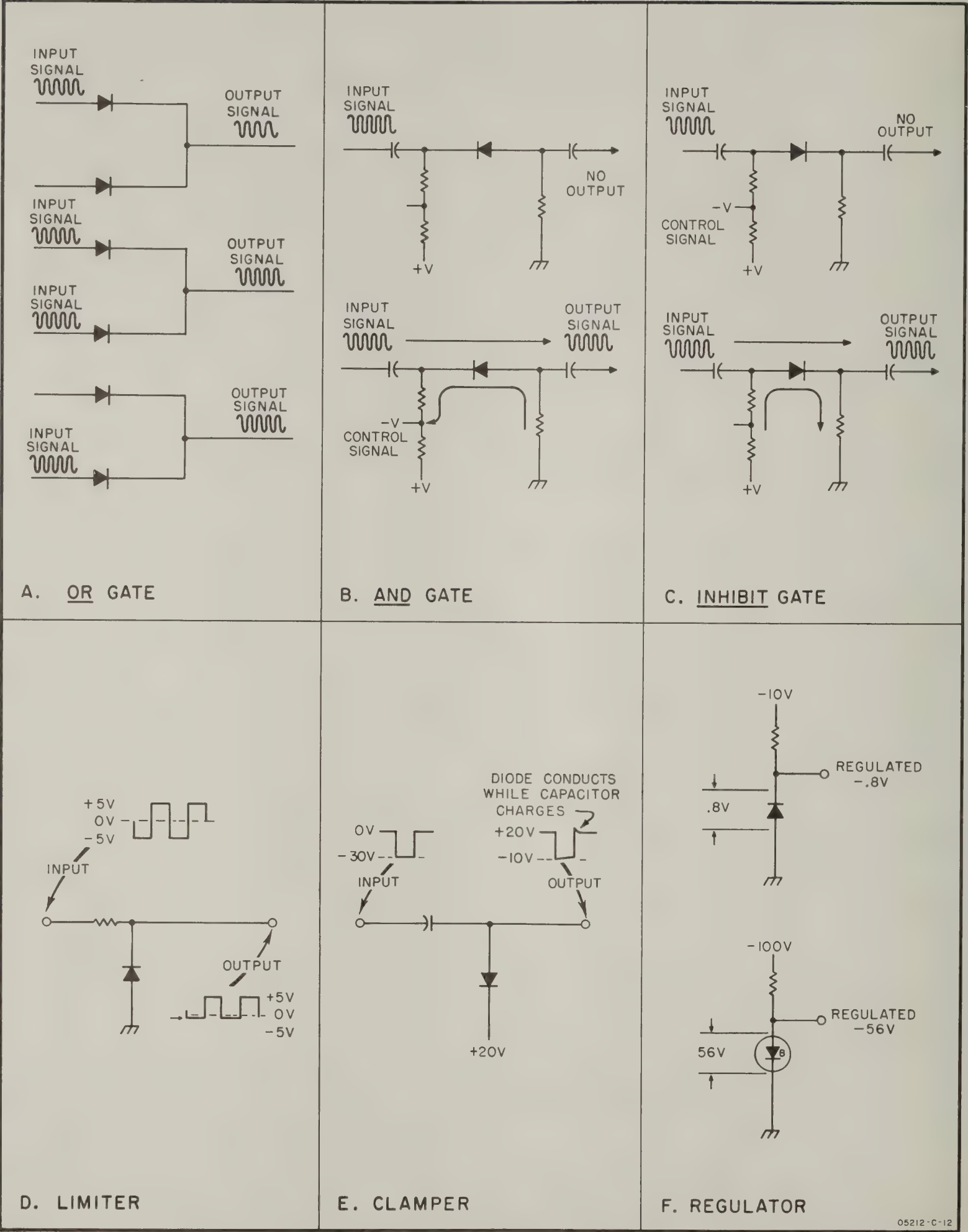
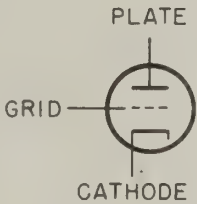
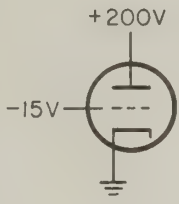
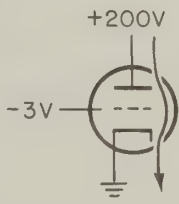
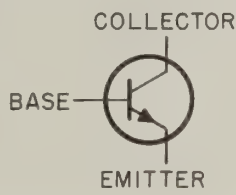
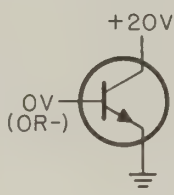
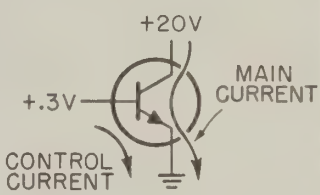
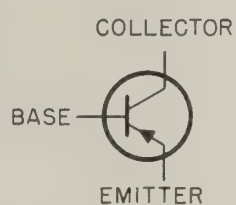
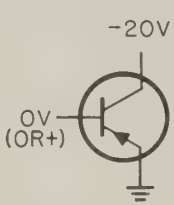
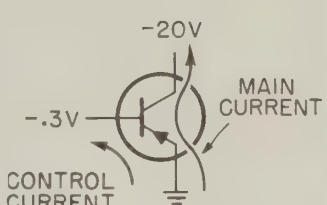
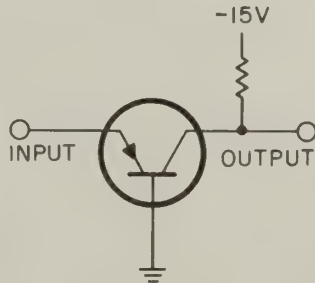
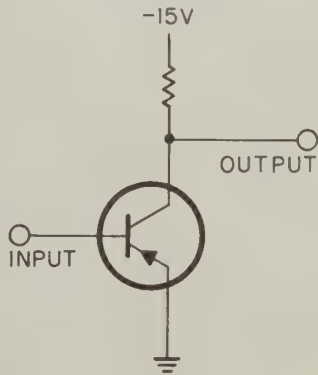
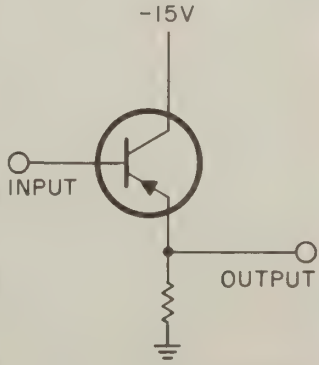


Figure 4-1. Basic Diode Circuits

A. TRANSISTOR BIASING			
DEVICE	SYMBOL	CUTOFF	CONDUCTING
VACUUM TUBE			
N P N TRANSISTOR			
P N P TRANSISTOR			

B. AMPLIFIER CHARACTERISTICS			
CHARACTERISTIC	COMMON BASE	COMMON EMITTER	COMMON COLLECTOR
INPUT Z	30-50 Ω	500-1500 Ω	20-500K Ω
OUTPUT Z	300-500K Ω	30-50K Ω	50-1000 Ω
VOLTAGE GAIN	500-1500	300-1000	<1
CURRENT GAIN	<1	25-50	25-50
POWER GAIN	20-30 db	- 25-40 db	10-20 db
			

05212-C-19

Figure 4-2. Transistor Operation

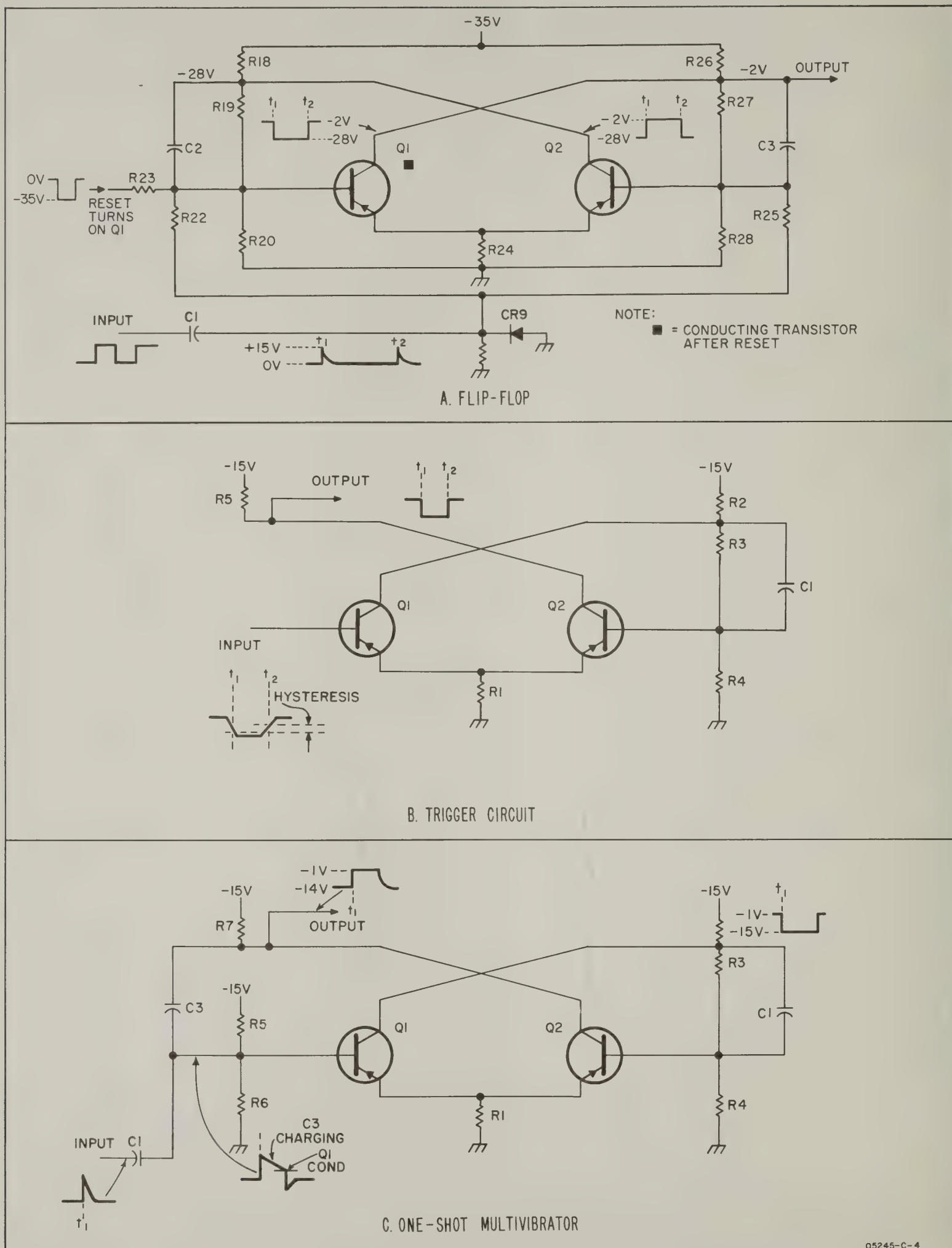


Figure 4-3. Basic Transistor Circuits



MANUAL CHANGES

MODEL 5232A/5532A

ELECTRONIC COUNTER

Manual Serial Prefixed: 306-

Manual Printed: JULY 1964

MAKE ALL CORRECTIONS IN THIS MANUAL ACCORDING TO ERRATA BELOW, THEN CHECK THE FOLLOWING TABLE FOR YOUR INSTRUMENT SERIAL PREFIX (3 DIGITS) OR SERIAL NUMBER (8 DIGITS) AND MAKE ANY LISTED CHANGE(S) IN THE MANUAL.

► NEW ITEM.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES	SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
306-	ERRATA		

ERRATA

Table 1-1, Specifications,
Under: TIME BASE STABILITY
Aging Rate: 2 parts in 10^7 /month.

Figure 5-6, Page 5-13,
Change R15 to 4700 ohms.

Figure 5-18, Page 5-25,
Change the input signal connection from pin 4 to pin 3.

4-16. At time t_1 the positive input pulse cuts off Q1; the Q1 collector voltage goes negative and drives Q2 into conduction (R27-R28 divider to Q2 base); the Q2 collector voltage and the Q1 base voltage (R19-R20 divider) then become considerably less negative, permitting Q1 to remain cut off. The R26-R27-R28 divider delivers a sufficiently negative voltage to the base of Q2 to drive it into conduction. In a similar manner the positive input pulse at time t_2 cuts off Q2 and starts a sequence of events which ends with Q1 conducting and Q2 cut off. Note that a positive input pulse has no effect on Q1 if it is already cut off. A negative reset pulse applied to the base of Q1 returns the flip-flop to its initial condition (Q1 conducting, Q2 cutoff). The diode CR9 removes the negative pulse from the differentiated square wave input. Without this diode, the negative pulse would drive Q1 which is cut off and the stage would switch from one state to the other but would not divide by two. The AC coupling through C2 and C3 insures fast switching. The DC coupling through R19 and R27 insures bistable characteristics.

4-17. BINARY CIRCUIT. In this manual a flip-flop which completes its operating cycle and produces an output pulse after receipt of two similar input pulses is called a binary circuit, since it is a counting device in a binary system. The binary circuit is driven from a single input which is connected either through a pair of resistors or through a pair of gating diodes to each transistor base.

4-18. TRIGGER CIRCUIT. The trigger circuit is a limiter or squaring circuit which produces an output waveform with very fast rise and fall times. The trigger circuit is similar to the flip-flop except that the RC network in one half is replaced by the input signal. Capacitor C1 bypasses R3 to couple fast changes in voltage at the Q1 collector to the base of Q2. Either Q1 or Q2 can conduct depending on the voltage at the input. Note that there is a slight difference in input voltage (called hysteresis) between switching with a negative-going input (time t_1) and switching with a positive-going input (time t_2).

4-19. ONE-SHOT MULTIVIBRATOR. The one-shot multivibrator is a circuit which generates a pulse of some specified duration following the application of a suitable triggering pulse. The circuit is similar to the flip-flop except one DC coupling path has been removed so the circuit is stable only in the state with Q1 conducting.

4-20. In the typical one-shot multivibrator shown in Figure 4-3C the following conditions exist during the initial stable period: the R5-R6 divider delivers a sufficiently negative potential to the base of Q1 to hold Q1 in saturation; the Q1 collector and Q1 emitter are therefore slightly negative; the R3-R4 divider delivers the Q2 base an even smaller negative voltage to hold Q2 cut off.

4-21. The positive triggering pulse at time t_1 reduces conduction of Q1; the resulting negative-going voltage at the Q1 collector is applied to the Q2 base through the R3-R4 divider (C2 bypasses R3 to provide coupling for the rapidly changing voltage at the Q1 collector);

Q2 begins to conduct; the resulting positive-going change in Q2 collector voltage is coupled through C3 to the Q1 base to further decrease Q1 conduction. The process is regenerative and quickly results in Q1 being cut off and Q2 being saturated.

4-22. Capacitor C3 now charges at a rate mainly determined by the values of R6 and C3 (main charge path: R1-Q2-C3-R5). When the Q1 base voltage becomes sufficiently negative, Q1 begins conduction; the resulting positive-going Q1 collector voltage is coupled to the Q2 base; the Q2 collector voltage goes negative and is coupled through C3 to the Q1 base to further increase Q1 conduction. The process is regenerative and ends with the circuit in its original quiescent state, Q1 saturated and Q2 cut off.

4-23. BASIC OPERATION OF DECIMAL COUNTER OR DECADE DIVIDER.

4-24. INTRODUCTION. Operation of the decimal counter circuit and the decade divider circuit is similar. The difference between the two is in function. Decimal counter circuits divide the input signal by 10 and actuate the digital display tubes, whereas the decade divider circuits are used to divide the input signal or the output of the internal oscillator into the frequencies to be counted or frequencies to provide the various gate times. Throughout the following discussion, circuits are referred to as "counters" though the description applies equally to decade dividers. Paragraphs 4-25 through 4-29 cover general operation of the counters with emphasis on counting logic; Paragraphs 4-30 through 4-33 discuss readout circuits; and Paragraphs 4-59 through 4-64 discuss specific decimal counter assemblies.

4-25. INPUT AND OUTPUT FROM BINARY. Figures 4-4A and 4-4B show a flip-flop connected for operation as a binary circuit (basic flip-flop operation is discussed in Paragraphs 4-15 and 4-16). Positive input pulses go to the bases of both transistors and cause switching by cutting off the conducting transistor. Negative reset pulses go to the base of one transistor and turn it on. Note the letter "A" near one transistor and " \bar{A} " (read as "A bar" or "not A") near the other. The positive-going transition at the collector of the \bar{A} transistor (while switching from A conducting to \bar{A} conducting) provides the input to the next binary circuit.

4-26. CIRCUIT ARRANGEMENT AND COUNT NOTATION. Figure 4-4C is a block diagram of a typical four-binary decimal counter. Notice that the \bar{B} output is applied to the D, \bar{D} , and \bar{C} transistors and that the \bar{D} output is applied only to the C transistor. Each input pulse produces a different combination of conducting and cut-off stages; there are only 10 allowable combinations and each combination represents a decimal digit. Decimal weighting is the decimal value assigned, arbitrarily, to the output of a pair when the plain-letter transistor is conducting.

a. **Decimal Count.** Decimal weighting used in the Model 5232A/5532A counter is shown in Figure 4-4C, immediately above each of the four binary stages. The decimal weight each pair represents is present only when the plain-letter side (A, B, D, or C) is conducting; when the barred-letter side (\bar{A} , \bar{B} , \bar{D} , or \bar{C}) is conducting, the decimal weight is zero. The decimal count can be determined by adding the decimal weighting of the four stages. For example, if the A, \bar{B} , D, and C transistors are conducting, where A=1, B=0, D=4, C=2, the output is $1 + 0 + 4 + 2 = 7$.

b. **Binary-coded Decimals.** In binary-coded decimal notation, the output is either 1 (when the plain-letter transistor is conducting) or 0 (when the barred-letter transistor is conducting). In binary-coded decimal notation, the order of the binaries is given so that binary-coded decimals can be written with the least significant digit to the right. Thus in the system used in the Model 5232A/5532A, the binary-coded decimal notation normally is given in the order DCBA. (Counter binaries are shown in the ABDC order on the schematics and in Figure 4-4C to increase clarity in showing signal flow.) For the decimal count of 7 used as an example in Paragraph a, with D=1, C=1, B=0, A=1, the binary-coded-decimal number would be 1101.

4-27. **SEQUENCE.** Figure 4-5 shows the counting sequence for a typical decimal counter. Initially each binary is in the "0" (reset) state (decimal count = 0, DCBA = 0000). The following action takes place when a series of input pulses is applied to the counter.

a. The first pulse switches A to the "1" state (DCBA = 0001 = $0 + 0 + 0 + 1 = 1$).

b. The second pulse switches A to the "0" state; the output from \bar{A} causes B to switch to the "1" state (DCBA = 0010 = $0 + 0 + 2 + 0 = 2$).

c. The third pulse switches A to the "1" state (DCBA = 0011 = $0 + 0 + 2 + 1 = 3$).

d. The fourth pulse switches A to the "0" state; the output from \bar{A} switches B to the "0" state; the output from \bar{B} switches both D and C to the "1" state; the resulting signal from C is applied to B and D to return B to the "1" state and D to the "0" state (DCBA=0110). Although \bar{D} is connected to C, no switching occurs at C as a result of the final switching of D since C has not fully recovered from its recent switching.

e. The fifth pulse switches A to the "1" state (DCBA = 0111 = $0 + 2 + 2 + 1 = 5$).

f. The sixth pulse switches A to the "0" state; the output from \bar{A} switches B to the "0" state; the output from \bar{B} switches D to the "1" state (DCBA = 1100 = $4 + 2 + 0 + 0 = 6$).

g. The seventh pulse switches A to the "1" state (DCBA = 1101 = $4 + 2 + 0 + 1 = 7$).

h. The eighth pulse switches A to the "0" state; the output from \bar{A} switches B to the "1" state (DCBA = 1110 = $4 + 2 + 2 + 0 = 8$).

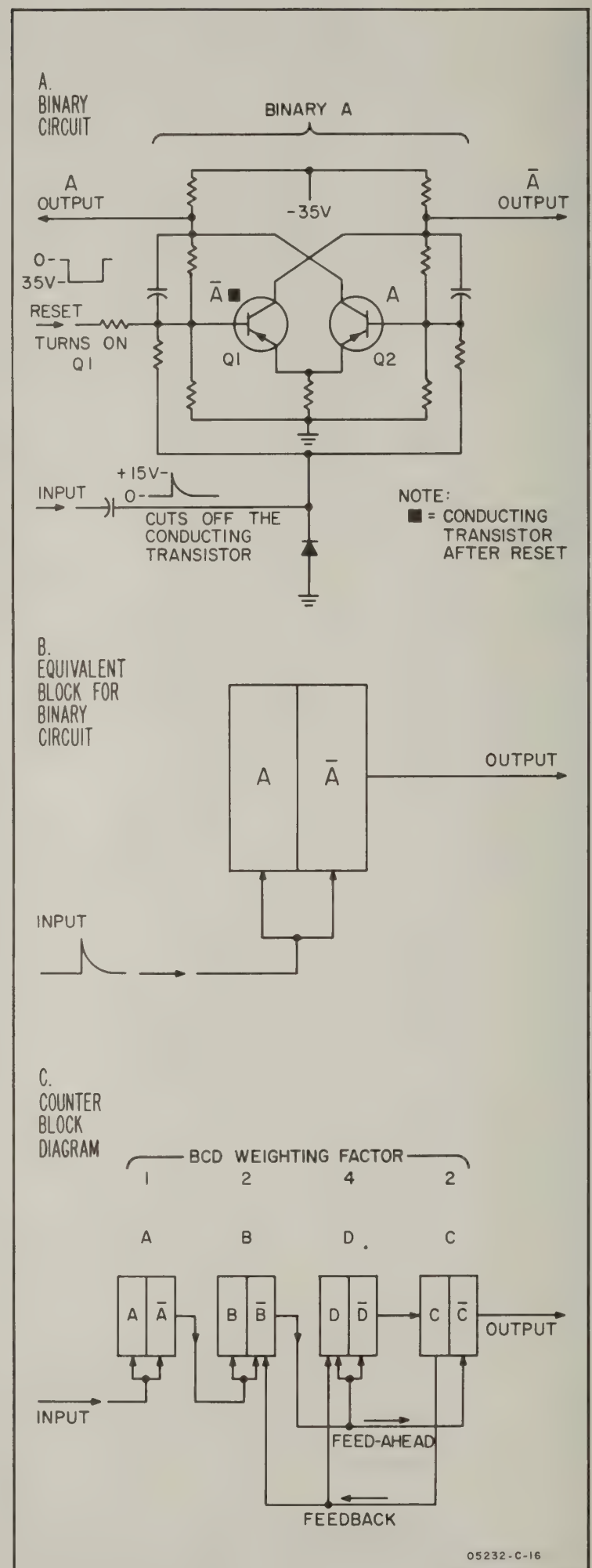


Figure 4-4. Basic Four Binary Counter

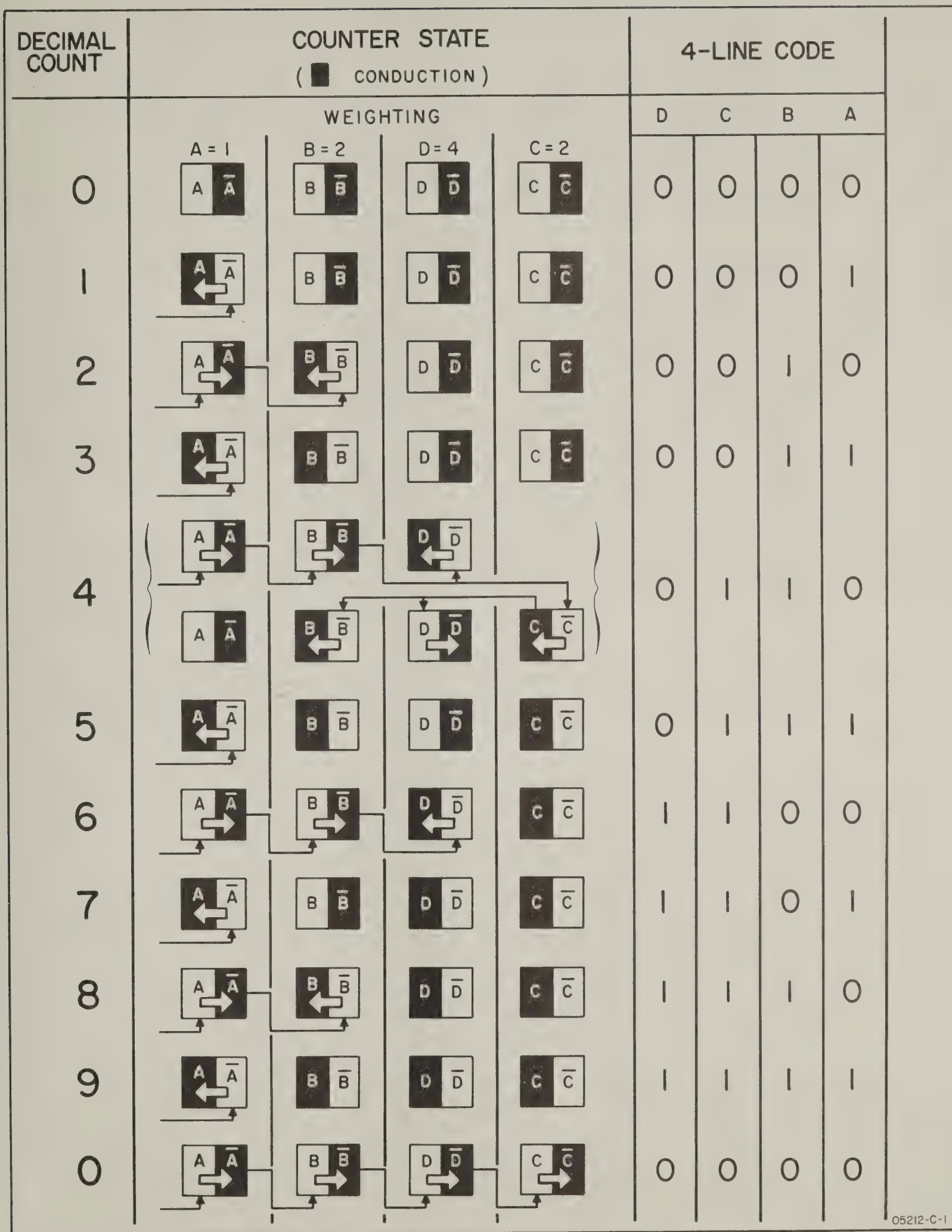


Figure 4-5. Counting Sequence of Four Binary Counter

i. The ninth pulse switches A to the "1" state; (D, C, B, A = 1111 = 4 + 2 + 2 + 1 = 9).

j. The tenth pulse switches A to the "0" state; the output from \bar{A} switches B to the "0" state; the output from \bar{B} switches D to the "0" state; the output from \bar{D} switches C to the "0" state (DCBA = 0000). When C becomes "0", \bar{C} produces an output pulse which serves as a carry pulse to a following decimal counter assembly. The counter is now returned to its original count.

4-28. RESETTING TO ZERO. The reset pulse, (negative) is applied to the base of the "0" state transistors (\bar{A} , \bar{B} , \bar{D} , \bar{C}) in each binary circuit. If the "0" state transistor is conducting, the pulse has no effect; if the "0" state transistor is not conducting, the pulse turns it on. Thus the reset pulse ensures that all four "0" state transistors are conducting. Figure 4-6 indicates a decimal counter assembly receiving a reset pulse. The counter is in the decimal "4" state (DCBA 0110) and the reset pulse returns the decimal counter assembly to the decimal "0" state (DCBA 0000). Decade dividers can be reset as required to any desired state, since reset inputs are available at each transistor. Note the difference between a regular input pulse and a reset pulse: a regular input signal is positive, and causes a conducting transistor to cut off; a reset pulse is negative, and causes a cut-off transistor to conduct.

4-29. Waveforms showing time relationships for the counter are given in Figure 4-7; remember that a driven binary switches only when the input wave is going positive. (Diode clipping removes negative portion of input).

4-30. ELECTRICAL READOUT. A four-line binary-coded-decimal output is available from each decimal counter assembly. A voltage representing the state of each binary is taken from the collector of each of the plain-lettered transistors (A, B, C, and D). A binary "9" is represented by a relatively positive voltage on each line, and a binary "0" is represented by a relatively negative voltage on each line. Table 4-1 summarizes the ten allowable combinations which represent the decimal digits "0" through "9". To protect the binary circuit from being effected by the load, each output line includes a 100K ohm series-connected isolation resistor.

Table 4-1. Four-Line Code Truth Table

Digit	4-Line Code, 0 = negative state 1 = positive state			
	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	1	0
5	0	1	1	1
6	1	1	0	0
7	1	1	0	1
8	1	1	1	0
9	1	1	1	1

4-31. DIGITAL DISPLAY. A display matrix, consisting of eight neon input lamps and 18 photoconductive elements is used to convert the binary-coded representation to a digital representation. The display matrix is shown in Figure 4-8. Figure 4-8A is a diagram of the physical layout of the matrix, and Figure 4-8B indicates the circuit paths to the various digits in the display.

4-32. As indicated in Figure 4-8B, the circuit to each numeral in the display is brought through three series-connected photocell elements. A characteristic of the photocell element is that it is a high resistance element (several megohms) when dark and a relatively low resistance element (less than 7000 ohms) when illuminated. Thus when the three photocell elements which constitute a circuit path are illuminated, resistance drops to about 20,000 ohms and sufficient current can flow to light the display digit. Illuminating elements for the photocells are neon lamps, one of which is connected in the collector circuit of each of the eight transistors in the counting circuit; the lamp lights when the transistor conducts. As explained in Paragraph 4-30, a four-binary counting circuit has ten states, ten combinations of conducting and nonconducting transistors, each combination corresponding to one digit. Thus there is a pattern of lighted lamps for each digit. Assigning a binary weight of 1 when the plain-letter lamp (A, B, C, or D) lights, and a weight of 0 when the bar lamp (\bar{A} , \bar{B} , \bar{C} , or \bar{D}) lights, the lamp pattern for any digit can be determined from Table 4-1. Figure 4-8 shows the counting circuit with transistors D, C, \bar{B} , \bar{A} conducting. The lamps associated with these circuits illuminate the photocell elements in the circuit to the digit 6 display.

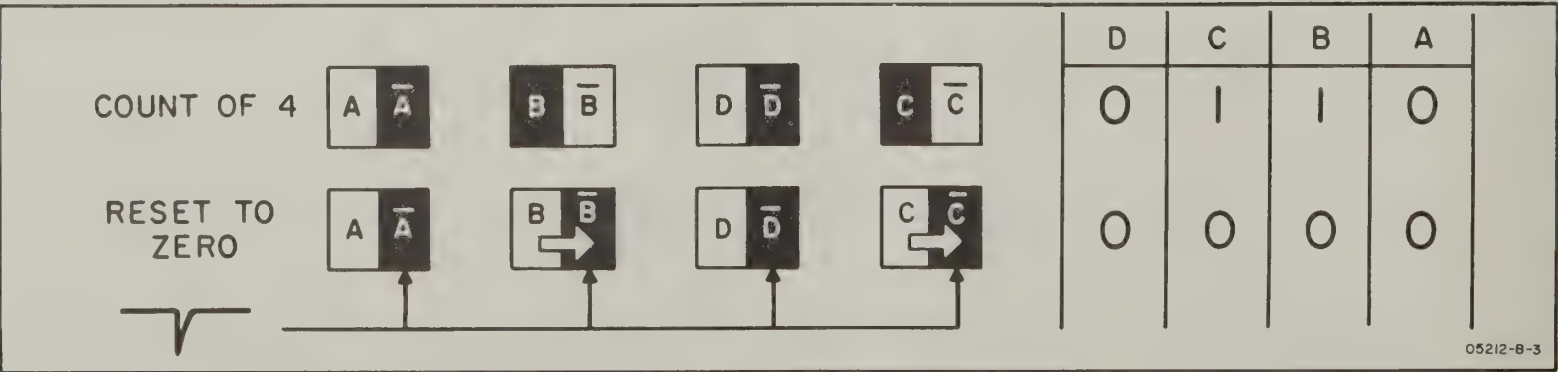


Figure 4-6. Typical Reset Operation in Four-Binary Decimal Counter Assembly

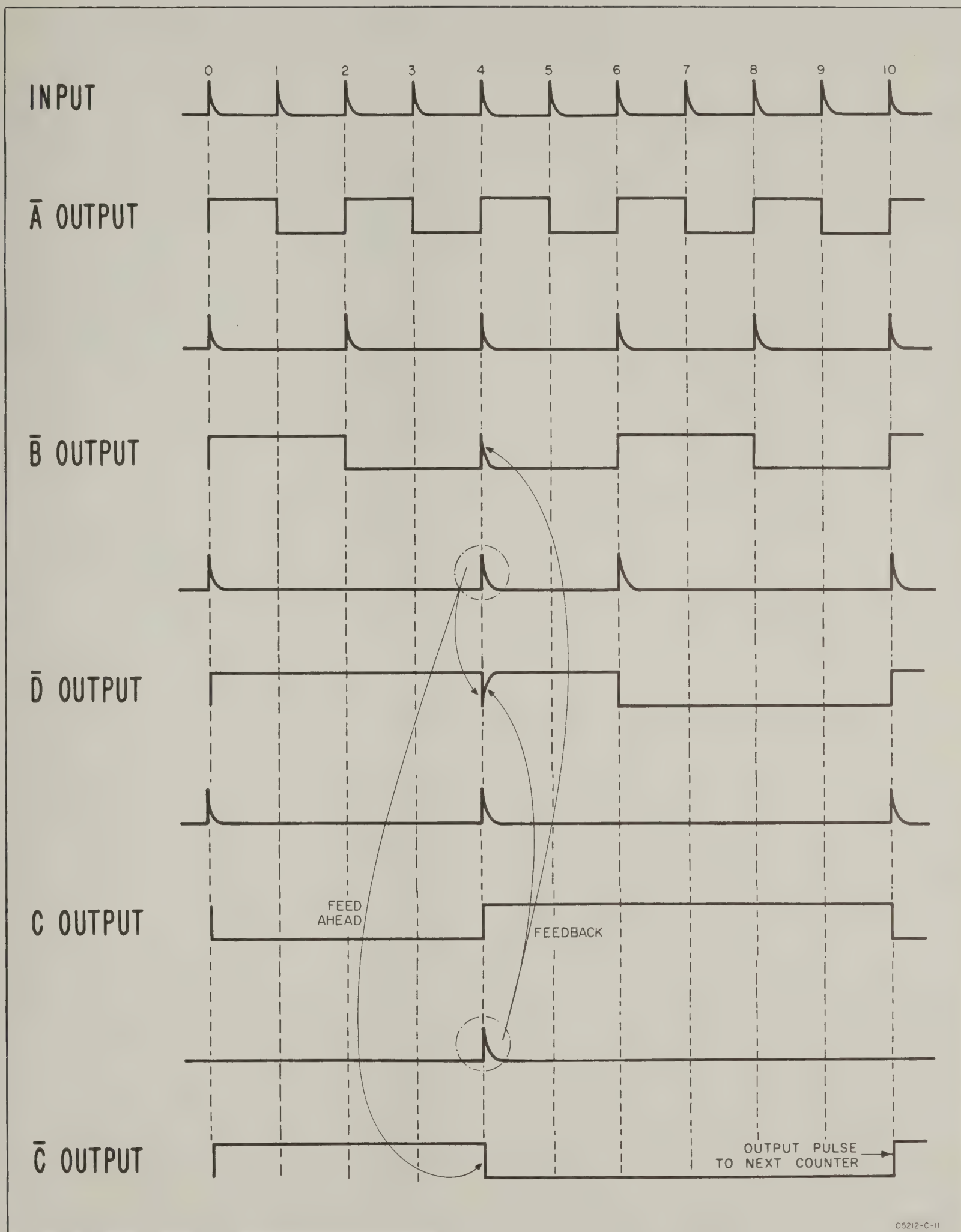


Figure 4-7. Waveforms in Four Binary Counter

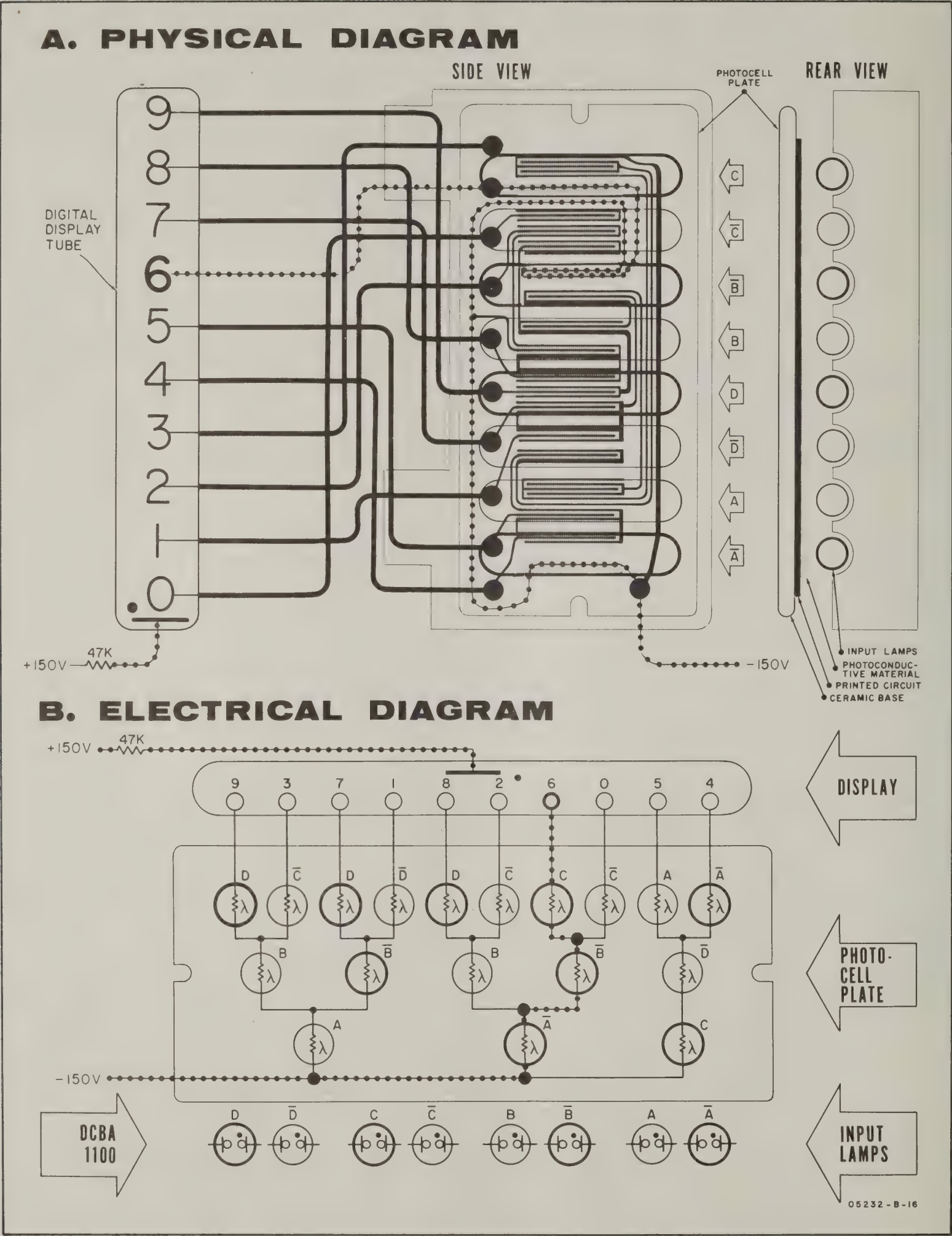


Figure 4-8. Display Matrix

4-33. The circuit sequence required to light a lamp is discussed in the following paragraphs. The sequence discussed will have more meaning if it is remembered 1) that a much higher voltage is required to fire a neon lamp than to maintain illumination in the lamp (for the lamps used in the Models 5232A/5532A, 70 volts for firing and 55 volts for maintaining illumination), and 2) that after application of the firing voltage the lamp cannot fire immediately because of the time required for ionization. Arrangement of the binary lamp circuit used in the Models 5232A/5532A is indicated in Figure 4-9B. As will be discussed later, diodes connected between the lamps make it possible for the circuit to store a previous count even though the binaries are switching during the next counting period. In decimal counter assemblies which do not have this storage feature, the display changes with each step the binaries take in setting up the circuit for a given digit. To clarify certain aspects of the lamp circuit sequence, the lamp circuit will first be discussed as though there were no diodes between the two lamps of a binary; this circuit is shown in Figure 4-9A.

a. Lamp Circuit without Diodes:

- (1) As indicated in Figure 4-9A-1, the lamp associated with the conducting transistor is lighted, the lamp associated with the nonconducting transistor is dark. Typically, voltages will be as shown. Since the transistor associated with the dark lamp is not conducting, no current is flowing in the circuit of the dark lamp, and voltage across it is established (a) by the circuit of the conducting lamp and its transistor, and (b) by the voltage on the collector of the non-conducting transistor. This voltage is not high enough to fire the dark lamp.
- (2) When the binary shown in Figure 4-9A changes state, the voltage on the collector of transistor \bar{A} (now conducting) drops to -1 volt, while the voltage on the collector of nonconducting transistor A rises to -30 volts. With transistor A turned off, current through lamp A decreases, and the voltage at the junction of the two lamps rises. Since lamp \bar{A} cannot fire until ionized, voltage will continue to rise after 70-volt level is reached, and typically will reach approximately 93 volts during the ionization period. After the dark lamp fires, the voltage across it stabilizes at about 55 volts, and since the circuit to the other lamp is open, the other lamp extinguishes.
- (3) Circuit state after lamp \bar{A} has fired is shown in Figure 4-9A-2; it is the mirror image of that shown in Figure 4-9A-1.

b. Lamp Circuit with Diodes. The steady, or storage, state of the lamp circuit is indicated in Figure 4-9B-1. The diodes are forward-biased, effectively connecting the lamps in parallel and clamping them to approximately -1.5 volts. One lamp is conducting, the other lamp is dark. Since both lamps are clamped to -1.5 volts, regardless of the state of the binary, there will never be sufficient voltage across

the dark lamp to fire it and it will remain dark until 1) the diodes are reverse-biased and 2) there is conduction through the transistor in whose collector circuit the lamp is connected.

- (1) When the gate closes at the completion of the counting period (see Paragraph 4-75) a -30 volt transfer pulse (see Paragraph 4-81) is applied to the binary diodes, reverse-biasing them. With the diodes reverse-biased, the lamps are disconnected from each other, and the circuit for each lamp is now completed through its associated transistor.
- (2) If the digit recorded by the binary is the same as that recorded during the previous counting period, the lamps "see" the voltages required to maintain them without change. If, however, the digit is such that the binary state is changed, the lamps change state. With the diodes reverse-biased, circuit action is the same as that described in subparagraph a. Condition of the circuit during the initial period of the transfer pulse when voltage across the dark lamp is increasing is indicated in Figure 4-9B-2; circuit condition after the lamp has fired is indicated in Figure 4-9B-3.

c. Disabling the Storage. When the function selector is set to MANUAL or the STORAGE switch on the rear panel is in the off position, the storage feature is disabled. Circuit action is then described in subparagraph a.

4-34. BASIC COUNTER FUNCTIONS.

4-35. GENERAL.

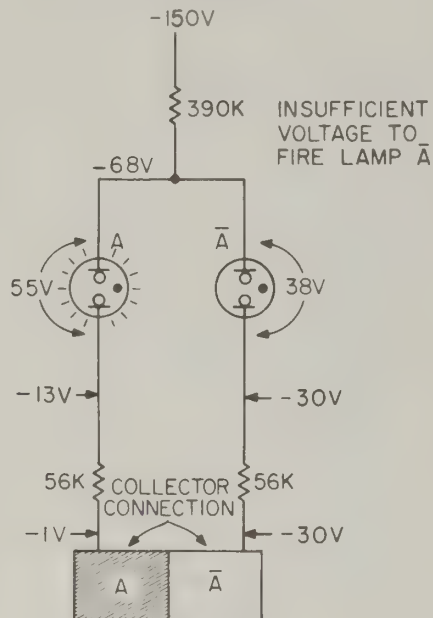
a. The basic counter circuits are arranged to provide several functional modes of operation. Each arrangement includes a main gate with 1) a signal input and 2) a control input, or gating signal. Following the main gate is a cascaded series of decimal counters which accumulate and display the total number of pulses which pass through the main gate. The various modes of operation are discussed in Figures 4-10 to 4-15.

b. Circuit sequence in various modes of operation is similar: pulses pass through the main gate to the decimal counter assemblies for a predetermined period, are counted and displayed. The difference between arrangements is in 1) the source of the pulses counted, and 2) the source of the gating signal which establishes the length of time during which the main gate is open and pulses pass to the decimal counter assemblies.

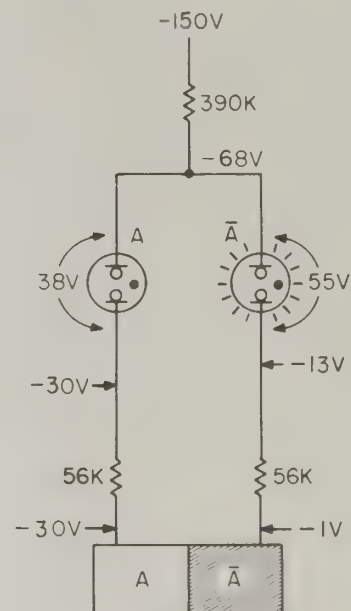
c. In the following discussion of the various modes of operation, remember that when the gate is open there is a circuit path to the decimal counter assemblies and they receive pulses; when the gate is closed the circuit path to the decimal counters is blocked and they do not receive pulses.

A. WITHOUT STORAGE

1. RUNNING STATE WITH
TRANSISTOR A CONDUCT-
ING, LAMP A FIRED,
LAMP \bar{A} EXTINGUISHED.



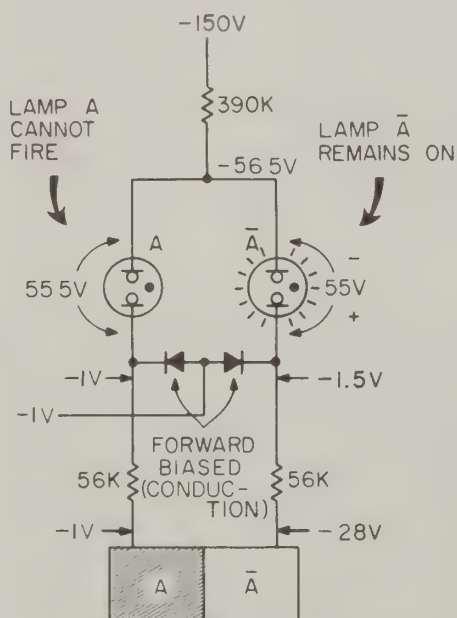
2. LAMPS CHANGE STATE,
LAMP \bar{A} FIRED, LAMP A
EXTINGUISHED.



B. WITH STORAGE

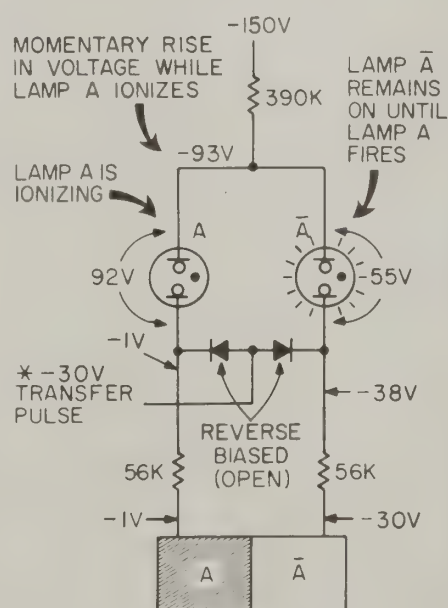
1. STORAGE

TRANSISTOR A CONDUCTING.
BUT LAMP A CANNOT FIRE:
LAMP \bar{A} ON, TRANSISTOR \bar{A}
NOT CONDUCTING.



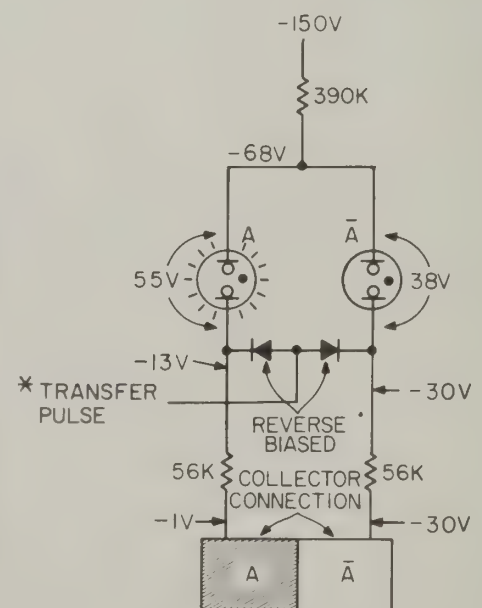
2. TRANSFER BEGINS

CONDITIONS DURING
INITIAL PERIOD OF
TRANSFER PULSE



3. TRANSFER COMPLETE

CONDITIONS DURING
FINAL PERIOD OF
TRANSFER PULSE



* TRANSFER PULSE
7.0 MILLISECONDS

NOTE: LAMP VOLTAGES, TYP: FIRES AT 70V AFTER IONIZATION DROP ACROSS
LAMP STABILIZES AT APPROXIMATELY 55V.

05232-B-17

Figure 4-9. Lamp Control

4-36. TOTALIZING. In the totalizing mode (figure 4-10), the gate flip-flop is triggered by the MANUAL START-STOP switch. The decimal counter assemblies cascade-count the total number of input pulses applied while the main gate is held open manually.

4-37. FREQUENCY MEASUREMENT. The circuit arrangement shown in figure 4-11 permits control of the main gate by the counter time base. The gate is opened for a controlled time, therefore the accumulated count represents the number of input cycles (or pulses) during this time. Controlled intervals are from 1 second down to 1×10^{-5} second in decade submultiples, selectable with the front panel function selector. The decimal point is automatically positioned so the readout is always in kilocycles. In the frequency mode, the gate flip-flop is triggered by the counter time-base circuit.

4-38. PERIOD MEASUREMENT. The arrangement shown in figure 4-12 provides the means for measuring the period of the input signal. The period of a signal is the time required for the completion of one cycle; the counter displays the time in milliseconds or microseconds. The period measurement is obtained by making the duration of the gating signal equal to the period of the input signal, and counting a train of pulses supplied by the counter time base. The displayed count is the number of time-base pulses which occur during one period of the input signal; the decimal point is positioned so that the readout is in milliseconds of microseconds. For multiple period measurements, the input signal is divided by the selected multiple of one period. The decimal point is automatically positioned to give the readout in milliseconds per single period of the input signal.

4-39. RATIO MEASUREMENT. As shown in figure 4-13, the frequency ratio of two inputs can be measured by a circuit arrangement similar to that used for period measurement. One input signal is applied to the main gate while the gating signal is made equal to the period (or decade multiple of the period) of the other signal. The displayed count represents the number of cycles of one input which occurs during the period of one cycle (or decade multiples of one cycle) of the other input.

4-40. STANDARD FREQUENCY OUTPUT. The output of the internal 1 mc oscillator is available at STD connector J2 on the rear panel when S3 is in INT position.

Note

In the following discussion complete reference designations may be used to identify components. This is to prevent confusion between reference designations of components located on the chassis and components located on an assembly. For example, "R1" would refer to a component located on the chassis, while "A1R1" would refer to a component located on the input amplifier assembly A1.

4-41. TIMING CIRCUITS.

4-42. GENERAL. Closing of the main gate ends the predetermined counting period, and supplies the trigger pulse to the display and reset circuits and supplies the print command (Figure 4-14). The counter also uses a variable pulse; this pulse (the sample rate pulse) disables the main gate through the inhibit amplifier and prevents the start of a new count until after the transfer and reset operations are completed. The pulse which results in the actuation of the display (transfer pulse) is generated by the transfer multivibrator, and generation of the reset and inhibit pulses is controlled by the sample-rate multivibrator. Timing and other data about the pulses is described in Paragraphs 4-43 and 4-44; how the counter uses the pulses is described in the following subparagraphs.

a. **Transfer Pulse.** Application of the transfer pulse results in the transfer of the count from the binaries to the lamps. As discussed in Paragraph 4-32, the circuit to the digital display is through photocell elements that conduct when the lamps controlled by the binaries are lighted. During the time the binaries are counting the next digit, forward-biased diodes clamp the lamps at a relatively positive voltage to prevent the lamps from changing state when the binaries change state as they build up the count. To reinstate binary control of the lamps it is necessary to disable the clamping diodes; disabling is effected with the transfer pulse, a -30 volt pulse which reverse-biases the clamping diodes.

b. **Reset Pulse.** After the digit has been transferred from the binary circuit to the lamp circuit, the binaries must be reset to zero; a negative pulse is required (see Paragraph 4-82). When operating in the storage mode, operation would be satisfactory if the binaries were reset immediately after the count has been transferred to the lamp circuits. However, with the storage feature disabled (STORAGE turned off), it is desirable to hold the count in the binaries, thus maintaining the display until a new count is about to start. To take care of the non-storage condition, the circuit is designed so the display is always maintained, regardless of how slow a sample rate is used, until a new count is about to start. The sample rate is determined by the length of the inhibit pulse (subparagraph c), and the display is maintained under all conditions by timing the reset to occur eight milliseconds before the end of the inhibit pulse.

c. **Inhibit Pulse.** For a steady display and an accurate count of the next digit, it is necessary to keep the main gate closed until after the transfer and reset operations are completed. The sample rate pulse followed 8 ms later by the inhibit pulse is the means used to delay the opening of the main gate. The amount of delay desired in opening the gate varies with operating conditions and thus the length of the sample rate pulse has been made variable by operation of a front panel display control. How the inhibit pulse delays opening of the main gate is discussed below.

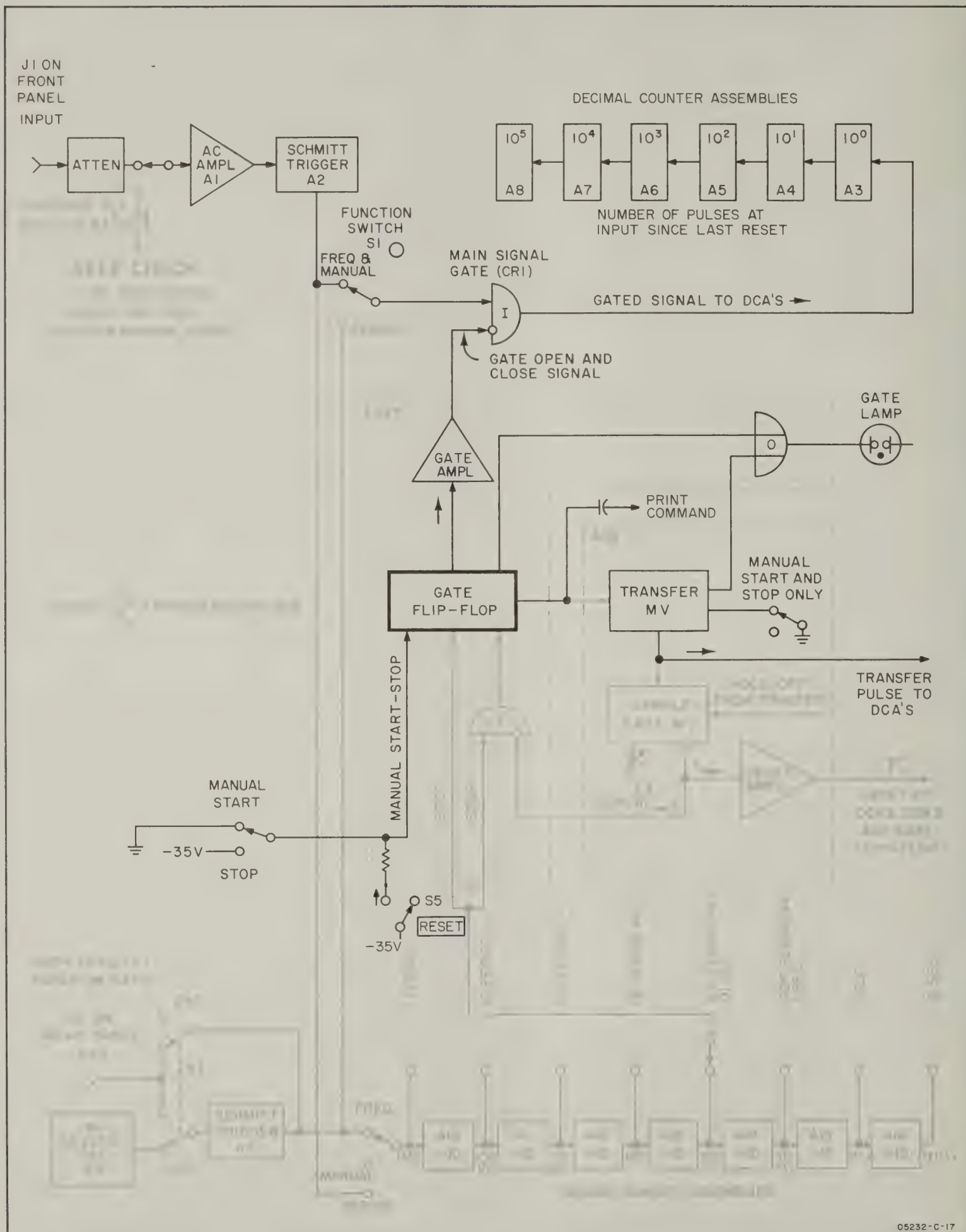


Figure 4-10. Basic Totalizing Counter

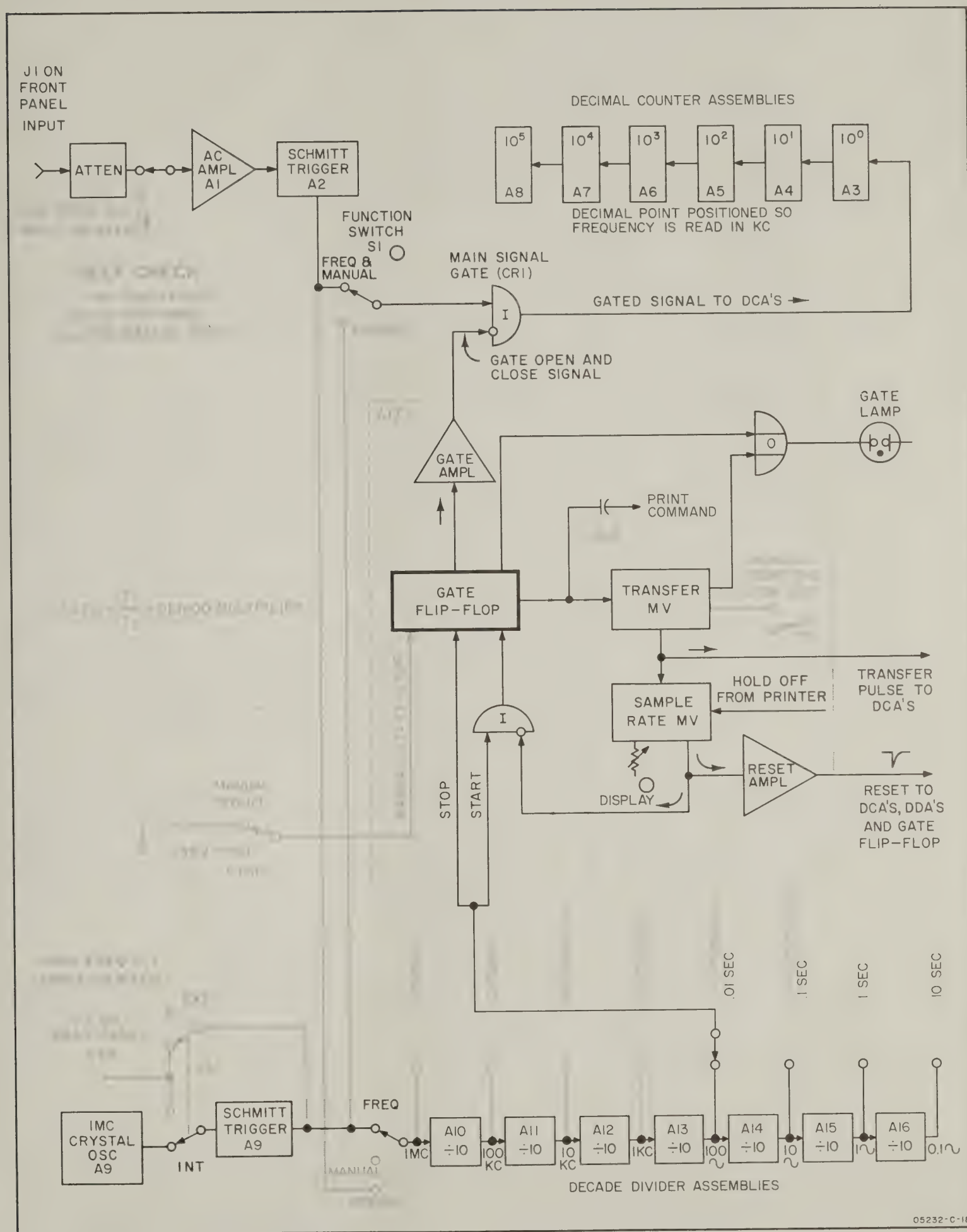


Figure 4-11. Basic Frequency Measuring Counter

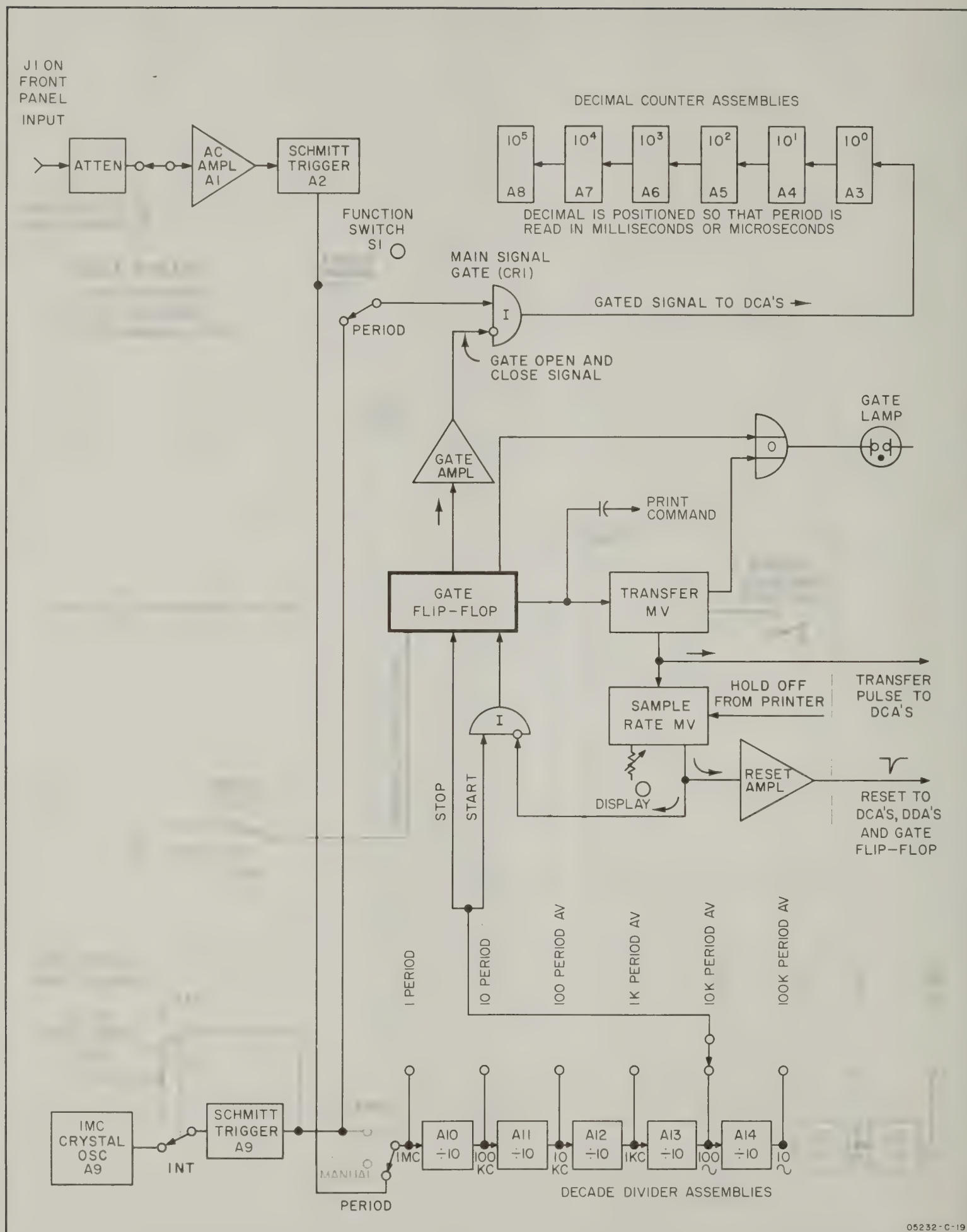


Figure 4-12. Basic Period Measuring Counter

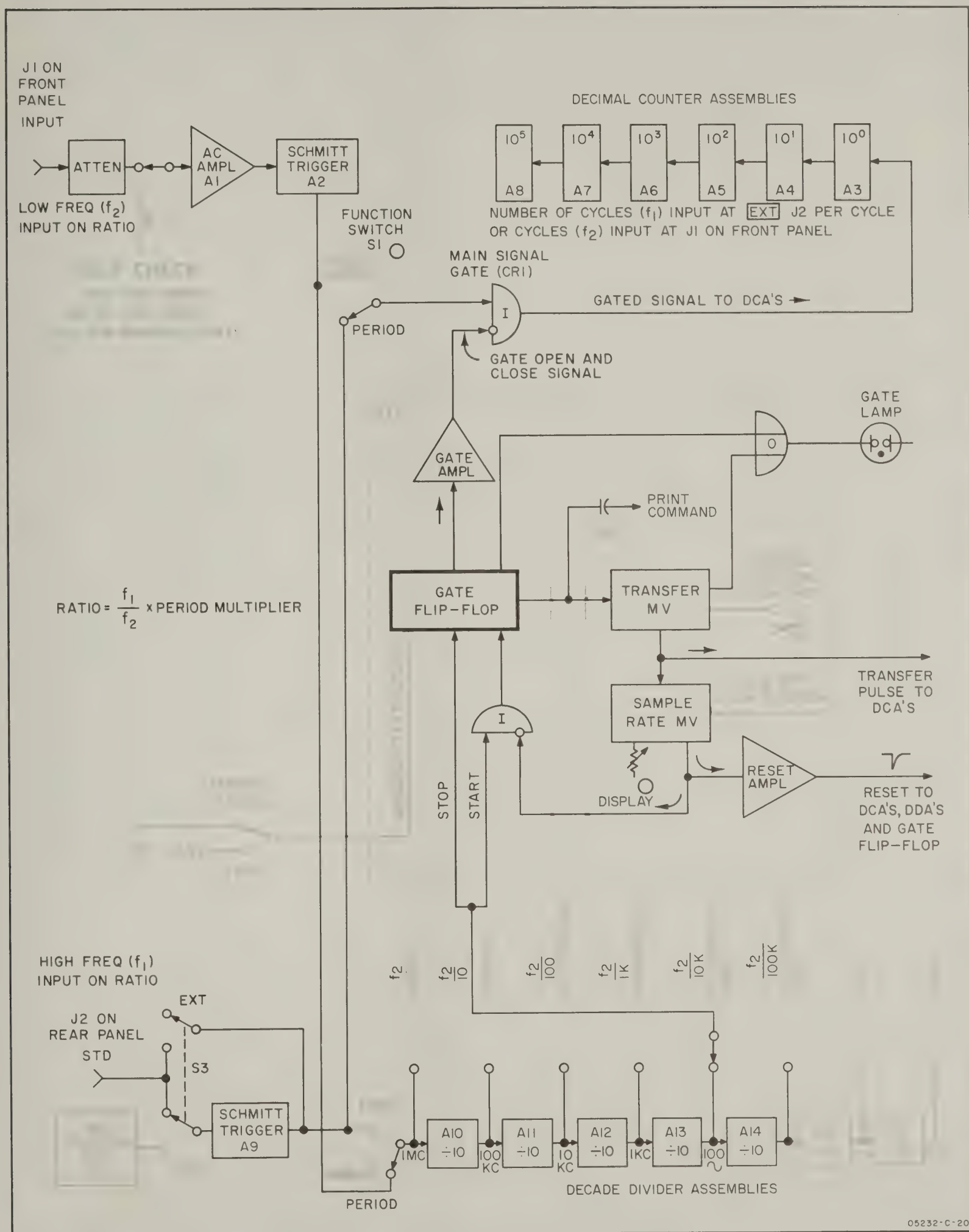


Figure 4-13. Basic Ratio Counter

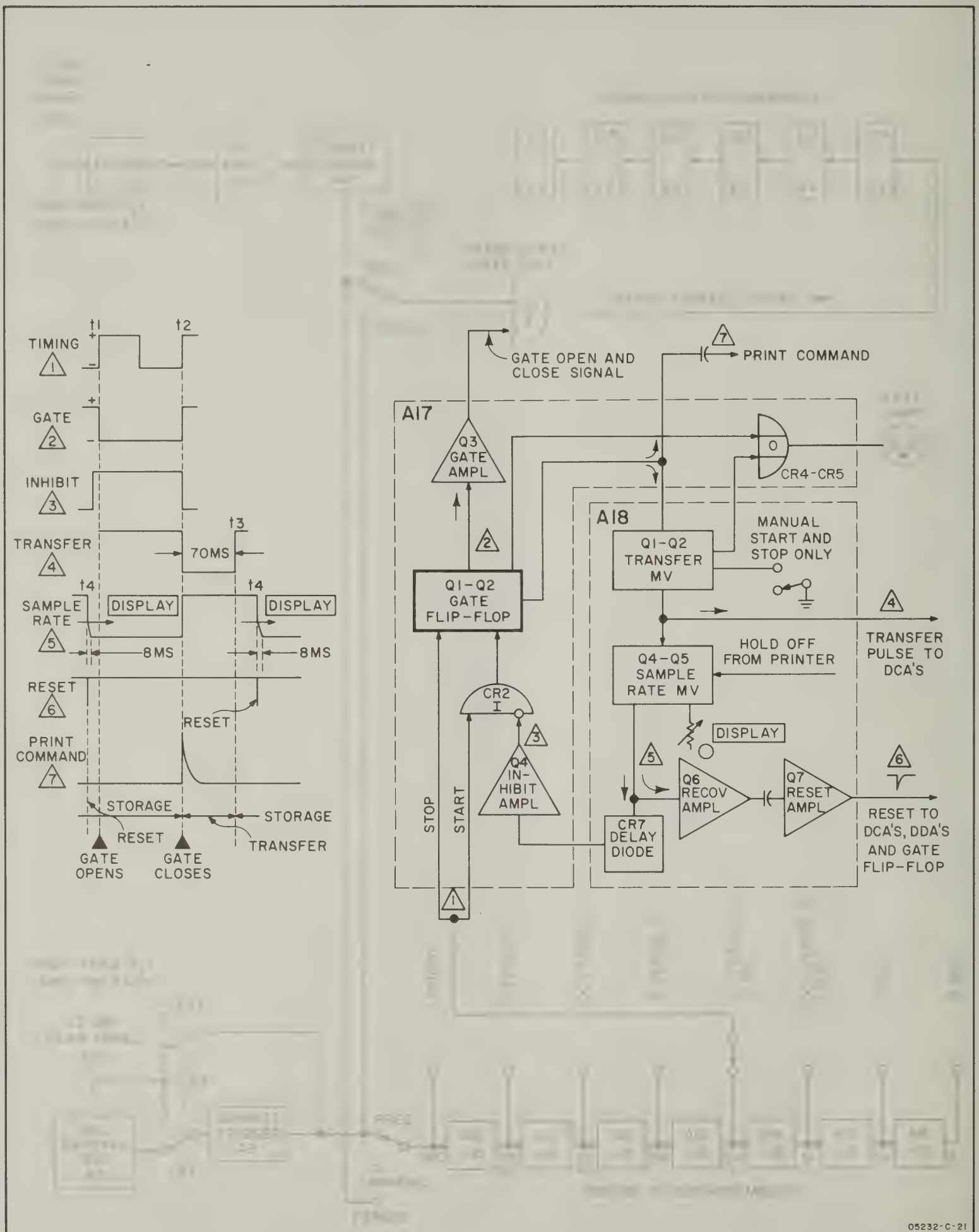


Figure 4-14. Timing Circuits Simplified Block Diagram

(1) The main gate is opened and closed by the gate flip-flop when the counter is operated in the frequency mode, the counter time base supplies the train of pulses which trigger the gate flip-flop. One pulse triggers the gate-opening, and the next pulse in the train triggers the gate-closing. When using short gates, more time is required to complete the transfer and reset operations than is available between the stop pulse and the next start pulse. To provide the required time between pulses, there is an inhibit gate in the start input to the gate flip-flop. The characteristic of an inhibit gate is that it is normally open, but upon application of a second signal it closes, preventing the passage of pulses for so long as the second signal is applied.

(2) The inhibit pulse, which is the signal that closes the inhibit gate, is supplied by the sample-rate multivibrator. The length of the inhibit pulse can be varied from 0.2 second to 5 seconds by changing the setting of variable resistor R8, which is brought out to the front panel as the display control.

Note

The main gate does not open at the end of the inhibit pulse; it is merely enabled and does not open until the gate flip-flop receives the next pulse in the train from the time base (i.e., the next pulse following completion of the inhibit pulse).

4-43. TRANSFER. The transfer multivibrator (A18-Q1, Q2), triggered at the end of the gating signal, produces a 70-millisecond pulse. The transfer pulse is applied to the decimal counters to transfer the new count to the display.

4-44. SAMPLE-RATE. The sample-rate multivibrator is triggered at the leading edge of the transfer pulse; it produces a variable 0.2-second to 5-second pulse.

a. Reset. The trailing edge of the sample-rate pulse resets the decimal counters and decade dividers.

b. Inhibit. The sample-rate multivibrator also produces the inhibit pulse, which starts at the leading edge of the transfer pulse and lasts until eight milliseconds after the end of the sample-rate pulse. This eight millisecond delay is due to the time required for the collector of A18Q3 to reach the breakdown potential of A18CR7. The inhibit pulse disables the gate flip-flop to prevent retriggering during transfer and display time, and until the decimal counters have reset to zero and reset transients have subsided.

4-45. OVERALL COUNTER OPERATION.

4-46. The counter is shown in block form in figure 4-15. The function switch (S1) switches signals to arrange circuits to perform each counter function.

4-47. INPUT SENSITIVITY CONTROL.

4-48. The input attenuator switch (designated SENSITIVITY on front panel) is a six-position switch (CHECK, 10v, 3v, 1v, 0.3v, and 0.1v). Refer to the schematic diagram, figure 5-6, for circuit details. Switch functions are listed below:

a. Provides five attenuation steps (0 db, 10 db, 20 db, 30 db, 40 db) for signal applied to INPUT connector J1. Attenuator output is connected to input amplifier A1.

b. Connects the 1 mc internal oscillator to the input amplifier A1 in the CHECK position.

4-49. FUNCTION SWITCH S1.

4-50. The function switch is a 12-position switch (MANUAL STOP, START: FREQUENCY with gate times of 0.01, 0.1, 1.0, and 10 seconds; PERIODS AVERAGED for 1, 10, 100, 1K, 10K, and 100K). Switch functions are listed below.

a. Connects all decimal point control voltages.

b. Applies start and stop input voltages to gate flip-flop (A17Q1-A17Q2) at pin 9 of the gate control assembly to force the gate flip-flop to gate open or gate closed state when switched to MANUAL START or MANUAL STOP.

c. Holds A18Q4 of sample rate multivibrator cut off by grounding its base at pin 3 of A18 and thereby keeps the sample-rate multivibrator in "state after reset" when switched to either MANUAL START or MANUAL STOP. This prevents operation of the sample-rate multivibrator which could trigger the reset circuit as the function switch is quickly switched from START to STOP to START.

d. Applies reset pulses by momentarily supplying -35 volts when the function switch is moved between positions, except in MANUAL START or STOP. This resets all counter circuits if function selection is changed during a measurement operation. Manual reset switch (S5) is connected to reset output at pin 14 of display control assembly A18.

e. Connects input frequency to decade divider string when in PERIOD mode or decimal counter string when in FREQUENCY mode.

f. Connects 1 mc internal time base to decimal counter string when in PERIOD mode or decade divider string when in FREQUENCY mode.

g. Connects output of proper decade divider assembly for selected gate timing to gate control assembly A17.

h. Disconnects gate lamp hold pulse (see paragraph 4-80) in MANUAL START and MANUAL STOP positions.

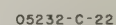


Figure 4-15. Simplified Functional Diagram

j. With SENSITIVITY control in CHECK position:

- (1) In any of the PERIOD positions: a) connects time base to input amplifier A1, and decimal counter assembly A3, b) connects output of input Schmitt trigger A2 to decade divider A0 (and to pin 13 of gate control assembly A17 in single period position), c) connects output of proper decade divider for selected gate timing to gate control assembly A17.
- (2) In any of the FREQUENCY positions: a) connects time base to decade divider A10, b) connects 100 kc signal (output of decade divider A10) to input amplifier A1, and c) connects output of proper decade divider for selected gate timing to gate control assembly A17.
- (3) In MANUAL START position: a) connects time base to decade divider A10, b) connects output of decade divider A14 (10 cps) to input amplifier A1, c) grounds the base of A17Q1 of the gate flip-flop thus keeping the main gate open, and d) grounds the base of A18Q4 of the sample rate multivibrator thus preventing any output pulses from the display circuit reaching the gate control flip-flop.
- (4) In MANUAL STOP position: connects -35 volts to the base of A17Q1 of the gate flip-flop thus keeping the main gate closed.

4-51. FUNCTIONS.

4-52. GENERAL. The function selector switch S1, figure 4-16, performs the key switching operations to arrange circuits for different measurements. The signal which is counted by the decimal counters is always present as one input to inhibit gate CR1 (paragraph 4-7). The other input is supplied by the gate flip-flop (A17Q1-A17Q2). The triggering pulse which is applied to the gate flip-flop is supplied by a) J1 for period and ratio measurement; b) decade dividers for frequency, multi-period and multiple ratio; and c) by dc levels from S1 for manual start and stop.

4-53. SIGNAL FLOW. The following outlines signal flow for each type of measurement.

a. MANUAL. Input signal amplified in A1, shaped in trigger assembly A2, passes to main signal gate and is applied to base of A3Q1 and A3Q2.

b. MANUAL CHECK. Same as MANUAL except that input to amplifier A1 is 10-cps signal taken from decade divider.

c. FREQUENCY. Input signal path same as for MANUAL. Main signal gate is opened and closed by selected frequency from decade divider.

d. FREQUENCY CHECK. Same as for FREQUENCY except that input to amplifier A1 is 100 kc signal taken from decade divider A10.

e. PERIOD. Input signal amplified in A1, shaped in A2, passes directly to input of gate flip-flop (base of A17Q1) and thus controls on-time of main signal gate. The internal time base is applied directly to main signal gate where it is counted.

f. PERIOD CHECK. There is no check in 1 period.

g. MULTI-PERIOD. Same as PERIOD except that output signal from A2 is input signal to decade divider A10. Selected output from decade dividers goes to gate flip-flop which opens and closes the main signal gate.

h. MULTI-PERIOD CHECK. Same as MULTI-PERIOD except that both input signal and signal which controls the main signal gate are supplied by the internal time base.

i. RATIO. Same as PERIOD, except J2 in EXT is high frequency (counted frequency) input and J1 is low frequency (gate open and close) input.

j. MULTI-RATIO. Same as MULTI-PERIOD except as noted in RATIO.

4-54. CIRCUIT DETAILS. Refer to the schematic diagrams, in section V, for circuit details. The basic INHIBIT gate description given in paragraph 4-7, applies to the main signal gate CR1. Note that the signal being counted does not go through CR1. The gate is open (signal passes to be counted) when CR1 is reverse-biased; the gate is closed (signal shunted through diode CR1 to ground) when CR1 is forward-biased. Operation of the trigger circuit (A2Q1-A2Q2) is similar to the circuit discussed in paragraphs 4-15 through 4-18.

4-55. INPUT AMPLIFIER ASSEMBLY A1.

4-56. The input amplifier provides amplitude discrimination for signals applied to J1 (signal INPUT connector) or J2 (STD connector on rear panel). A1Q1 and A1Q2 is used as an impedance multiplier. A1Q3 and A1Q4 is a feedback amplifier with a voltage gain of about 8. Diode A1CR1 is a diode limiter (paragraph 4-8). For circuit details, refer to schematic diagram Figure 5-6.

4-57. TRIGGER ASSEMBLY A2.

4-58. The trigger assembly uses a Schmitt trigger and is described in paragraph 4-18. For circuit details, refer to schematic diagram Figure 5-6.

4-59. 2-MC DECIMAL COUNTER ASSEMBLY A3.

4-60. GENERAL. The 2-Mc decimal counter operates in a manner similar to the low frequency counter. The circuits have been modified to speed up binary switching. Operation of basic circuits is discussed in the paragraphs listed in Table 4-2. Circuit details are given in the schematic diagram, Figures 5-8, 10.

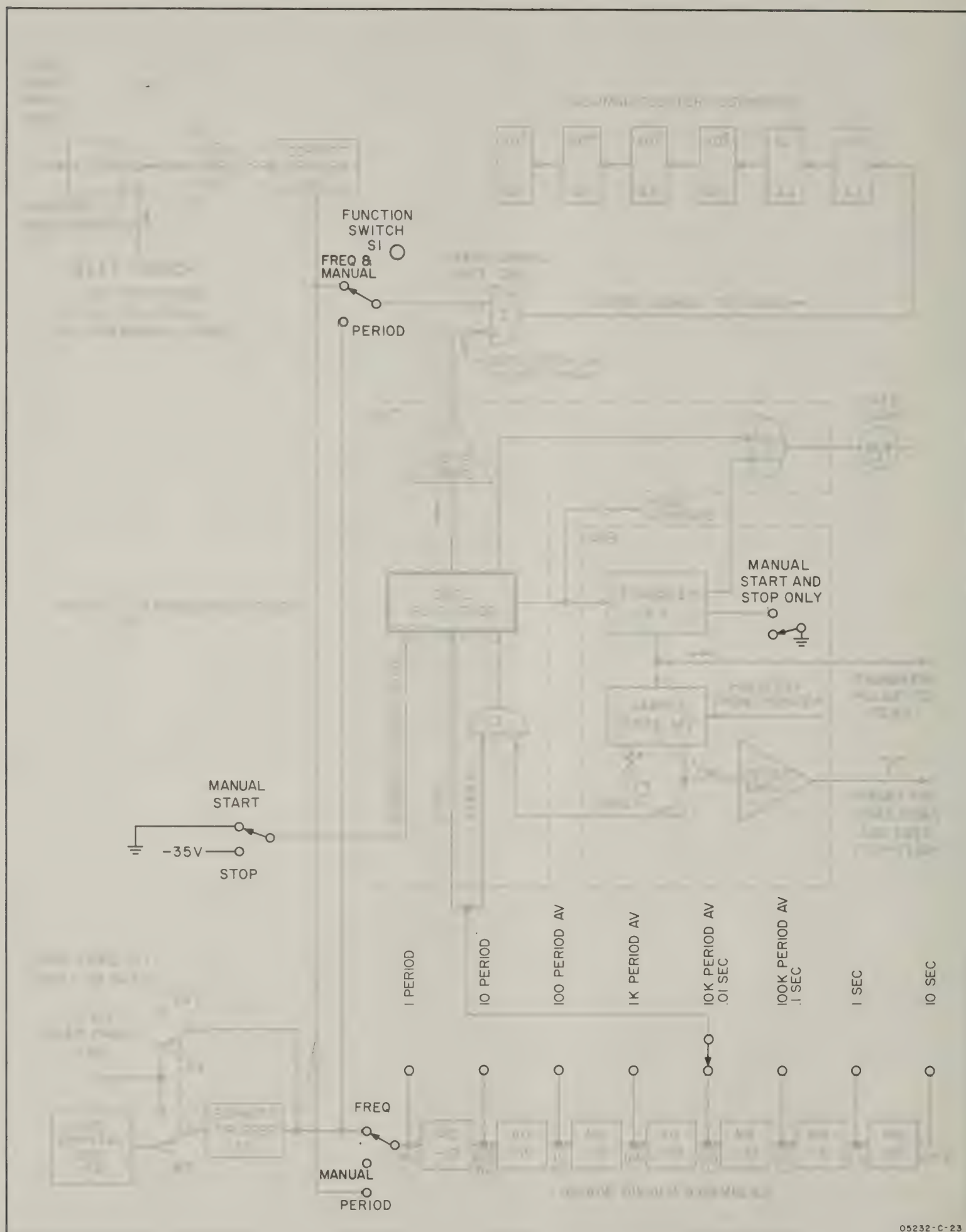


Figure 4-16. Block Diagram for Functional Control Switch S1

Table 4-2. Basic Operation Summary

Four Binary Counter	
Area	Paragraph Reference
Binary circuits and Counting logic	4-23 through 4-25
Resetting	4-26 through 4-27
Electrical readout	4-28
Digital display	4-30
Clipper diodes	4-31 through 4-33
	4-8

4-61. **STEERING DIODES.** Input leads to each transistor include series-connected steering diodes CR9 through CR20 which act as AND gates to permit applications of the input pulse to the conducting transistor only. For example, if binary A is in the "1" state (Q1 cut off, Q2 conducting), CR11 is forward biased as a result of the relatively negative voltage existing at the junction of the A input (Q2 base) and the CR11 cathode; CR11 therefore passes the positive driving pulse to the A input. At the same time CR9 is reverse biased as a result of the relatively positive voltage existing at the junction of the \bar{A} (Q1 base) and the CR9 cathode; CR9 therefore does not permit the positive input pulse to be applied to \bar{A} input.

4-62. **HIGH-FREQUENCY FEATURES.** Features which contribute to high-speed operation, contrasting circuits in the 2-Mc decimal counter with that of the lower-frequency counter described in Paragraph 4-63, include the use of a) steering diodes, b) high-frequency transistor types, and c) reduced time constants (smaller R, smaller C) in the interstage coupling networks.

4-63. 300-KC DECIMAL COUNTER ASSEMBLIES A4-A8.

4-64. The decimal counter is shown in figure 4-17A. Note the inclusion of clipper diodes CR9 through CR13 which permit only positive pulses to be delivered to the input base of each transistor. Operation of basic circuitry is discussed in the paragraphs listed in table 4-2. Circuit details are given in the schematic diagram, Figures 5-12, 14.

4-65. OSCILLATOR ASSEMBLY A9.

4-66. **GENERAL.** The first portion of the oscillator assembly A9 provides a 1 mc signal as an internal time base. The second portion of A9 shapes either the internally generated 1 mc or an externally supplied signal.

4-67. **OSCILLATOR AND TRIGGER.** The oscillator assembly includes the Q1 oscillator which is connected to the 1 mc crystal, Q2 which amplifies the signal, and the wave-shaping trigger Q3-Q4. The 1 mc oscillator output is supplied to the rear-panel STD jack where it usually is switched to the trigger (Q3-Q4). The 1 mc oscillator output is available at rear panel jack (STD) with switch in INT position.

4-68. **CIRCUIT DETAILS.** Refer to the schematic diagram, figure 5-16, for circuit details. The Q1 oscillator is a modified Colpitts oscillator. Limiter CR3 prevents signal extremities (see paragraph 4-8) from overdriving base of Q3. Operation of the trigger circuit (Q3-Q4) is discussed in detail in paragraph 4-18.

4-69. 1-MC DECADE DIVIDER ASSEMBLY A10.

4-70. The 1-mc decade divider assembly, reduces the frequency of its input by a factor of ten (normally 1 mc to 100 kc). Basic operation is identical to that described for the 2-mc decimal counter (paragraphs 4-59 and 4-62, except that there is no displayed count. Refer to the schematic diagram, figure 5-18, for circuit details.

4-71. DECADE DIVIDERS A11-A16.

4-72. A block diagram of a typical decade divider is shown in Figure 4-17b. A decade divider is an arrangement of four cascaded binaries (flip-flops) so that for every ten input pulses there is one output pulse. Consequently, when a frequency is applied to the input of the decade divider assembly, the first binary divides it by two (since the first pulse switches the binary to the opposite state and a second pulse is required to return it to its original state) and again by two in the second binary (making a total division by four) and so on, with an expected total division of sixteen at the output of the fourth binary. The desired division by ten is obtained by a feed-ahead pulse to the fourth binary and feedback pulses to the second and third binaries. Therefore, after the eighth input pulse is received, the binaries will be in a state as if they had counted fourteen pulses. Then, when the ninth and tenth pulses are received the desired final output pulse is produced. Operation is similar to that described for the decimal counters discussed in Paragraphs 4-23 thru 4-29 except that there is no display array connected to the binaries. Note that decade dividers A11 through A16 are provided with a reset input. The reset pulse resets the decade dividers so that only a certain number of input pulses to the decade dividers are necessary after reset before an output is produced. Thus even in the 10 second gate position only about 20 milliseconds elapses after reset before a gating signal is produced. In the multiple period positions the frequency being measured is routed through the decade dividers and a selected output provides the gating signal. It is thus possible to realize extremely long gate times for low frequency inputs. Refer to the schematic diagram, Figure 5-20, for circuit details.

4-73. GATE CONTROL A17.

4-74. **GENERAL.** The function of the gate control assembly is to generate the gating signal (which opens and closes the main signal gate CR1) and the transfer trigger (which starts the transfer multivibrator in assembly A18). Refer to the schematic diagram, Figure 5-21, for circuit details. All circuits are conventional; flip-flop operation is described in Paragraphs 4-15 and 4-16, and one-shot multivibrator operation is described in Paragraphs 4-19 through 4-22.



Figure 4-17. Decimal Counter and Decade Divider Block Diagram

4-75. **SIGNAL FLOW.** The gate flip-flop (Q1-Q2) is normally in its off state (holding the main gate closed, preventing counting) following a frequency or period measurement. With the gate flip-flop off, Q1 is saturated, and its emitter current is also the emitter current of gate amplifier Q3. With Q3 saturated its current supplies the bias current for inhibit gate diode CR1. So long as Q3 is conducting, the input signal is shunted to ground through CR1 (which constitutes the closed gate). The first pulse which occurs after the end of the reset pulse and release of inhibit gate amplifier Q4 turns Q1 off. When A17Q1 turns off, its collector goes negative and this negative step is transmitted through diode A17CR3 and A17R11 to back bias A17CR2 so that the next pulse cannot go through A17CR2.

4-76. With A17Q1 off, Q3 gets no current so neither does gate diode CR1. The main signal gate is now open so the signal is allowed to pass to the decimal counters for counting. The positive step output at the collector of A17Q2 allows diode A17CR4 of the "OR" gate to turn off the gate light amplifier. The combination of the positive transition at the junction of A17R16-A17R17 and gate amplifier A17Q5 being off drives front panel gate lamp DS1 on. When the gate closes, the gate lamp does not turn off because as the gate closes the transfer multivibrator is triggered (at the base of A18Q2) and a positive 70-millisecond pulse from collector of A18Q1 is sent back through diode A17CR5 of the "OR" gate (the complete "OR" gate includes both A17CR4 and A17CR5) to hold gate lamp DS1 on in the same manner as before. The gate lamp is therefore on while the gate is open plus 70 milliseconds; this ensures a visible flash from the lamp even for short gate open periods. (In MANUAL START or STOP, DC voltages are applied to the base of A17Q1 to force the gate flip-flop to the gate open or gate closed state regardless of other inputs).

4-77. When A17Q1 of the gate flip-flop is turned on at the end of a measurement, the positive step output at its collector 1) triggers the transfer one-shot multivibrator at the base of A17Q2; and 2) supplies directly the print command to pin 23 of digital recorder jack, J4 (this positive pulse tells the digital recorder to accept BCD information from the counter).

4-78. DISPLAY CONTROL A18.

4-79. **GENERAL.** During a frequency or period measurement, the display control assembly A18 receives the positive transfer trigger pulse from gate control assembly A17; outputs from the sample rate control assembly are a) the gate lamp hold pulse; b) the transfer pulse; c) the reset pulse; and d) the inhibit pulse. Refer to block diagram, Figure 4-14, and schematic diagram Figure 5-22 for circuit details.

4-80. **GATE LAMP HOLD PULSE.** When the gate flip-flop transistor A17Q1 starts to conduct, it 1) closes the main gate (Paragraph 4-75) and 2) applies a positive pulse through A18C1 to the base of A18Q2 of the transfer multivibrator A18Q1, Q2. This positive pulse turns A18Q2 off and its collector goes negative and turns on A18Q1. The resulting positive step at collector of A18Q1 is the gate lamp hold pulse and is coupled through A17CR5 to the gate lamp circuit.

4-81. **TRANSFER PULSE.** As transistor A17Q1 of the gate flip-flop starts to conduct, it 1) closes the main gate (Paragraph 4-75) and 2) applies a positive pulse through A18C1 to the base of A18Q2 of the transfer multivibrator A18Q1, Q2. This positive pulse turns A18Q2 off and as A18Q2 supplies emitter current to A18Q3, the transfer amplifier, it turns off also. As A18Q3 turns off, its collector goes negative and it is this negative transition which is the transfer pulse. This negative pulse back-biases the lamp diodes, as described in Paragraph 4-33, and permits transfer of the stored count to the front panel numerical display. The collector of transfer amplifier A18Q3 remains negative until A18Q3 recharges through A18R7, R8. Then A18Q2 turns back on (stable condition) and as Q2 turns on it turns A18Q3 on again and pulls the transfer line positive once more and the information is stored, as described in Paragraph 4-33. Resetting the counter manually (RESET pushbutton pressed or FUNCTION switch operated) forces the transfer multivibrator (A18Q1-A18Q2) to the transfer state by grounding the base of A18Q2. A zero count is then transferred to the front panel numerical display.

4-82. **RESET.** Refer to schematic diagram Figure 5-21 for circuit details. The positive transfer-triggering pulse from the collector of A17Q1 (which occurs at the time the main gate CR1 is closed) drives transfer multivibrator A18Q1, Q2 into its astable condition (Paragraph 4-21). The resulting negative transition at the collector of A18Q2 drives A18Q4 of the sample rate multivibrator A18Q4, Q5 into its astable condition. The length of time that it remains in the astable condition is determined by the charge path A18R16, A18C8 and display potentiometer R8. With the use of R8 it is possible to vary the time of the astable condition from 0.2 to 5 seconds. When the DISPLAY control is in the INFINITE position the sample rate multivibrator is held in the astable condition and the front panel display is held indefinitely. As the sample rate multivibrator returns to its stable condition the collector of A18Q4 goes negative and turns on A18Q6, the recovery amplifier. The positive transition from the collector of A18Q6 is differentiated and drives reset amplifier A18Q7 on. The negative output at the collector of A18Q7 is supplied as the reset pulse to the DCA's, DDA's, and the gate flip-flop. If manual reset occurs during the sample-rate multivibrator cycle, it is quickly returned to its stable state as a result of grounding the base of A18Q4 through A18CR6.

4-83. **INHIBIT.** When a stop pulse is received at the base of A17Q2 of the gate flip-flop (A17Q1-A17Q2), A17Q2 is turned off and A17Q1 turns on. The positive transition at the collector is coupled through A18C1 to the base of A18Q2 and drives the transfer multivibrator (A18Q1-A18Q2) into its astable state (A18Q2 off). The negative transition at the collector of A18Q2 is coupled through A18C5 and A18CR5 to the base of A18Q4 driving the sample rate multivibrator (A18Q4-A18Q5) into its astable state (A18Q4 on). The positive potential at the collector of A18Q4 is coupled through A18CR7 to the base of A17Q4, the inhibit amplifier. This positive potential is the inhibit pulse and while it is present A17Q4 is off and the negative potential at its collector back-biases A17CR2. Thus further

pulses at the start channel of the gate flip-flop (A17Q1-A17Q2) through A17CR2 are not accepted until completion of the sample rate multivibrator cycle. As the sample rate multivibrator is returning to its stable condition, it takes about eight milliseconds for the collector of A18Q4 to reach the -15 volts breakdown potential of diode A18CR7. During this time the inhibit pulse is still present and allows the sample rate multivibrator to complete its cycle. When diode A18CR7 breaks down, drive currents through A18R11 are supplied to the base of A17Q4 and it turns on. Its collector is now about 2 volts negative and A17CR2 is no longer back biased. The gate flip-flop start channel is now uninhibited and will accept the next start pulse.

4-84. PRIMARY POWER. As shown in figure 5-24 either 115 or 230 volts ac power is connected through fuse F1 and front panel power switch S7 to the primary of power transformer T1. Switch S8 (slide switch on rear panel) when in the up position connects the primaries in parallel for 115-volt operation. When S8 is in the down position the primaries are connected in series for 230-volt operation. Fan motor B1 is connected across a single primary winding of T1.

4-85. MINUS 35-VOLT SUPPLY. The regulated -35 volt supply consists of a full-wave rectifier (A19CR1 through A19CR4) whose output is smoothed by filter C17, regulated by Q2, and further filtered by A19C2 and A19C3. The A19R6, A19R7, A19R8 divider supplies a sample of the regulated output to A19Q1 which amplifies and inverts variations in the sample. The

A19Q1 output controls driver Q1 which in turn controls regulator Q2. Potentiometer A19R7 permits adjustment of the regulated output voltage by providing a means of adjusting A19Q1 bias.

4-86. REGULATOR OPERATION. Operation may be traced as follows: Suppose the output voltage tends to shift toward -34 volts. This causes the voltage at the A19Q1 base to go in a positive direction resulting in a decrease of conduction and a negative swing in A10Q1 collector voltage; driver A1 increased conduction (Q1 emitter and Q2 base voltage goes negative); regulator Q2 increases conduction and returns the output voltage to -35 volts.

4-87. OTHER REGULATOR COMPONENTS. Breakdown diode A19CR9 provides a 7.0 volt reference to the emitter A19Q1. The A19R4-A19C1 network provides phase correction for stability during transients.

4-88. MINUS 150 VOLT AND PLUS 150 VOLT SUPPLIES. Two conventional fullwave rectifiers supply unregulated +150 volts and -150 volts. Each rectifier circuit provides a 150 volt output filtered by C18 and C19.

4-89. RECORDER REFERENCE VOLTAGES. A19R9-R10-R11 make up a voltage divider to supply reference voltages when the counter is used with the Φ 562A Digital Recorder or Φ 580A/581A Digital to Analog Converter.

SECTION V

MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides maintenance and service information for the Model 5232A/5532A Electronic Counter. Included are a table of recommended test equipment, troubleshooting procedures, repair and adjustment procedures, and an in-cabinet performance check which may be used to verify proper operation of the counter.

5-3. AIR FILTER.

5-4. Inspect the air filter (center of rear panel) regularly and clean it before it becomes dirty enough to restrict air flow. Proceed as follows:

a. Remove both top and bottom covers from instrument.

b. Remove two screws holding filter in place.

c. Wash filter in solution of warm water and detergent.

d. Remove cleaning solution from filter by shaking. Allow filter to dry completely.

CAUTION

DO NOT APPLY ANY COATING COMPOUND
TO FILTER.










5-5. TEST EQUIPMENT.

5-6. Recommended test equipment for troubleshooting and performance checking is listed in table 5-1. Test instruments other than those listed may be used if their specifications equal or exceed the required characteristics.

5-7. ASSEMBLY CONNECTION IDENTIFICATION.

5-8. Throughout the manual, connections to printed circuit assemblies are referred to in abbreviated form. For example, the connection to pin 15 of assembly A17 is A17(15).

Table 5-1. Recommended Maintenance Test Equipment

Instrument Type	Required Characteristics	Use	Instrument Recommended
Oscilloscope	10-mc bandwidth, dual trace plug-in, ext sync capability	Observe waveforms during troubleshooting and adjustment	 Model 175A Oscilloscope  Model 1750A Dual Trace Vertical Amplifier  AC-21C Voltage Divider Probe (two)
Test Oscillator	Continuously variable from 10 cps to 1.2 mc, 1 volt output	Performance Check	 Model 650A Test Oscillator
Low Frequency Generator	Continuously variable from 2 cps to 10 cps, 100 mv output	Performance Check	 Model 202A Low Frequency Function Generator
Pulse Generator	1 μ sec wide, 1 v pulse, 1 kc repetition rate	Performance Check	 Model 212A Pulse Generator
Standard Frequency Source	100 kc sine wave, accuracy of 1 part in 10^8	Check accuracy of counter time base	 Model 107BR Quartz Oscillator
AC Vacuum Tube VOLTMETER	0 to 300 vac	Circuit Adjustment, Troubleshooting	 Model 400D/H/L, AC Vacuum Tube Voltmeter
DC VTVM and Ohmmeter	0 to ± 300 vdc 1% Accuracy 0 to 100 M ohms	Circuit Adjustment, Troubleshooting	 Model 412A

CAUTION

TO AVOID DAMAGE, REMOVE POWER FROM INSTRUMENT BEFORE REMOVING OR REPLACING INSTRUMENT COVERS, ASSEMBLIES, OR COMPONENTS.

5-9. INSTRUMENT COVER REMOVAL.

5-10. To remove top or bottom cover, unscrew and remove the four countersunk phillips-head screws which secure cover to instrument. Then slide cover toward rear of instrument. To replace cover, reverse procedure.

WARNING

115/230 VAC AND ± 150 VDC SUPPLY WIRES ARE EXPOSED WHEN EITHER TOP OR BOTTOM INSTRUMENT COVER IS REMOVED. EXERCISE EXTREME CAUTION DURING TROUBLESHOOTING, ADJUSTMENT, OR REPAIR.

5-11. IN-CABINET PERFORMANCE CHECK.

5-12. GENERAL. The following performance check verifies proper operation of all circuits in the Model 5232A/5532A Electronic Counter and may be used:

- a. as part of an incoming inspection check of instrument specifications,
- b. periodically, for instruments used in systems where maximum reliability is of utmost importance,
- c. as part of a troubleshooting procedure to locate malfunctioning circuits, and
- d. after any repairs or adjustments, before returning instrument to regular service.

5-13. VARIABLE LINE VOLTAGE. During the following tests, counter should be connected to power source through a variable voltage device so that line voltage may be varied $\pm 10\%$ from nominal (115 or 130 vac) to assure proper operation of counter under various supply conditions.

5-14. INPUT SENSITIVITY.

- a. Connect output of Test Oscillator to INPUT of Counter and to input of Oscilloscope with a BNC "T" connector. Set SENSITIVITY switch to .1 volt RMS.
- b. Vary frequency of Test Oscillator from 10 cps to 1.2 mc, keeping output constant at 100 mv rms. Counter should display properly both frequency and period at frequencies within this range as specified in table 1-1 specifications. Three or four spot checks across the band are sufficient.
- c. Substitute Low Frequency Generator for Test Oscillator. Repeat step a above for frequency range of 2 cps to 10 cps with 100 mv rms sine wave.

- d. To measure pulses, the input trigger circuit must be adjusted so that the hysteresis limits will be triggered by either a positive pulse or a negative pulse. Refer to paragraph 5-24 for this internal adjustment.

Note

Shifts in hysteresis limits to obtain a consistent count on a positive or negative pulse will affect sine wave sensitivity. Steps b and c above will require an input level above 100mv if the input circuit is adjusted for pulse operation.

- e. Perform following check only if trigger circuit has been adjusted for pulse operation. Connect Pulse Generator to INPUT of Counter with normal recommended load. Set Pulse Generator for $1\mu\text{sec}$ 1 volt pulse of the polarity used to adjust the trigger bias with a 1kc repetition rate. The Counter should display 1kc in FREQUENCY positions and 1 msec in PERIOD positions.

5-15. EXTERNAL STANDARD INPUT SENSITIVITY.

- a. Connect output of Test Oscillator to front panel INPUT connector and to rear panel STD connector with a bnc "T" connector.
- b. Set function switch to PERIODS 10K. Set EXT-INT switch (on rear panel) to EXT.
- c. Vary frequency of Test Oscillator from 100 cps to 1.2 mc, keeping output constant at 1 v rms. Counter should display $10,000 \pm 1$ count at any frequency in this range.

5-16. TIME-BASE OSCILLATOR STABILITY.

- a. Set function switch to MANUAL START.
- b. Set EXT-INT switch (on rear panel) to INT.
- c. Connect Oscilloscope to J2, STD bnc connector on rear panel.
- d. Trigger Oscilloscope externally with a 100 mc signal from a standard frequency source.
- e. Set Oscilloscope sweep time to $1\mu\text{sec/cm}$. Adjust Oscilloscope controls to obtain a presentation of a rectangular wave, approximately 1 v p/p.
- f. Horizontal drift of Oscilloscope display in cm/sec is difference between standard frequency and Counter time-base oscillator frequency in parts in 10^6 .
- g. Determine frequency difference in parts in 10^6 from Oscilloscope display. If display appears to drift to the left, time-base oscillator frequency is higher than standard frequency. If display seems to drift to the right, time-base oscillator frequency is lower than the standard frequency.
- h. Record frequency difference determined in step g.

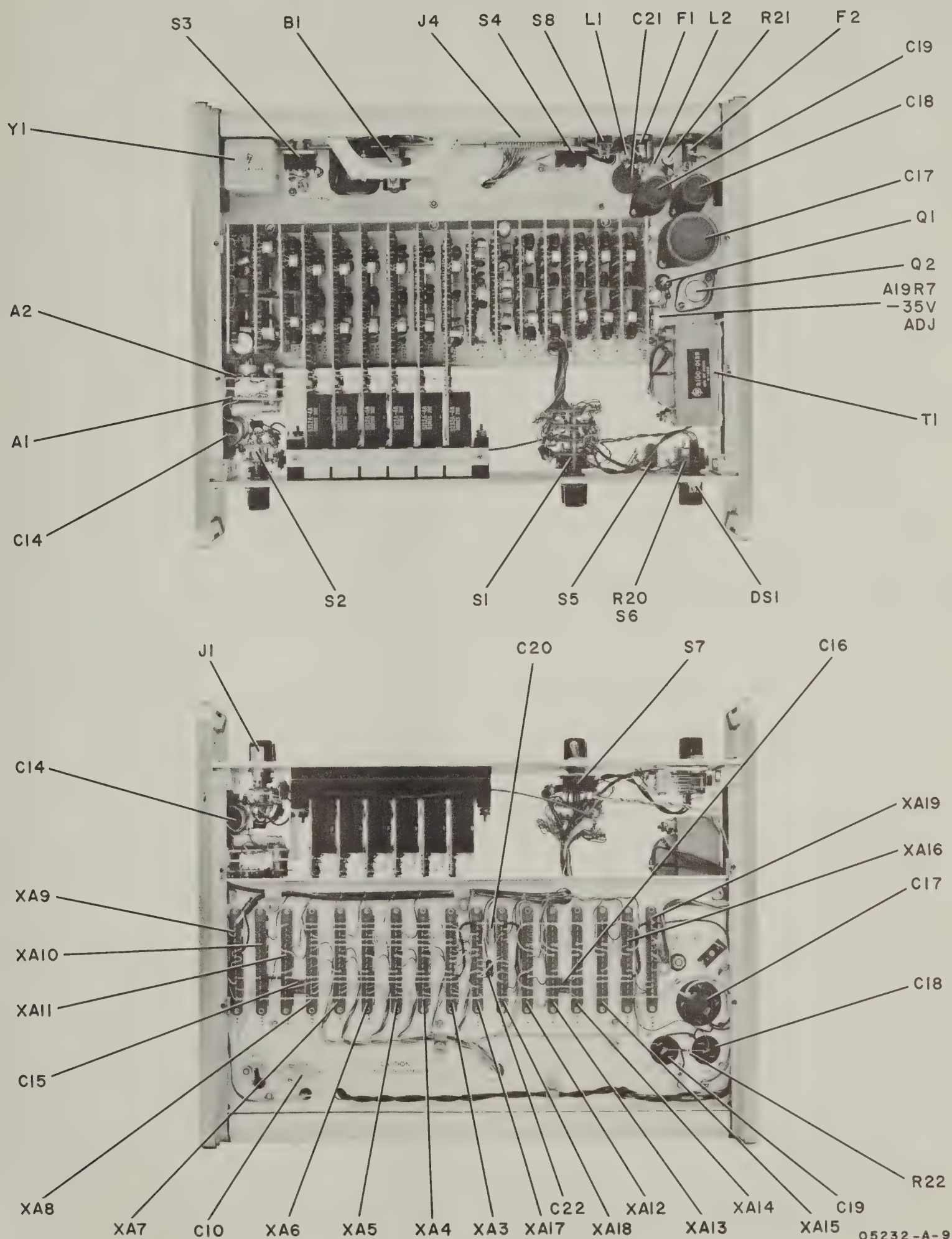
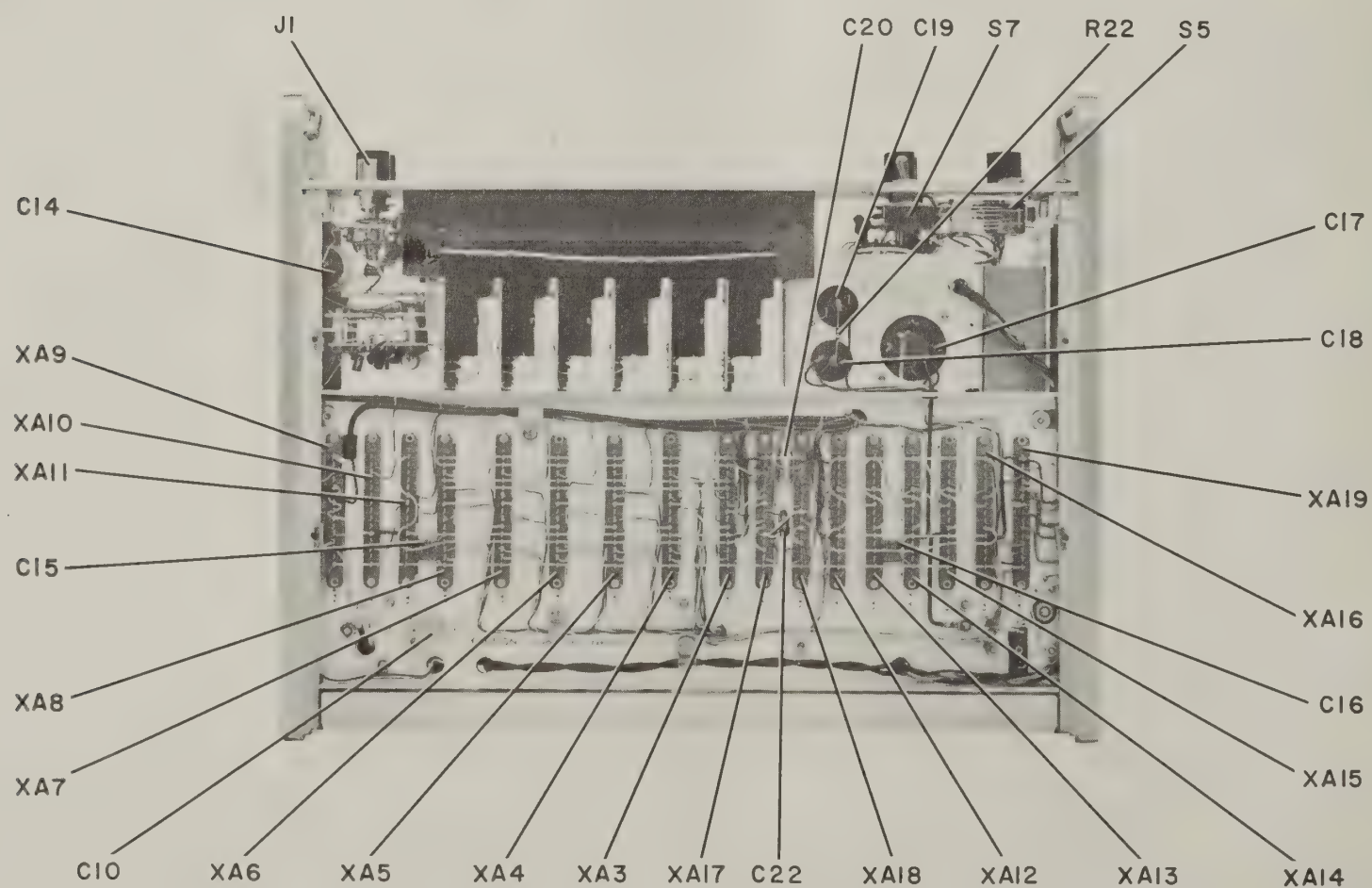
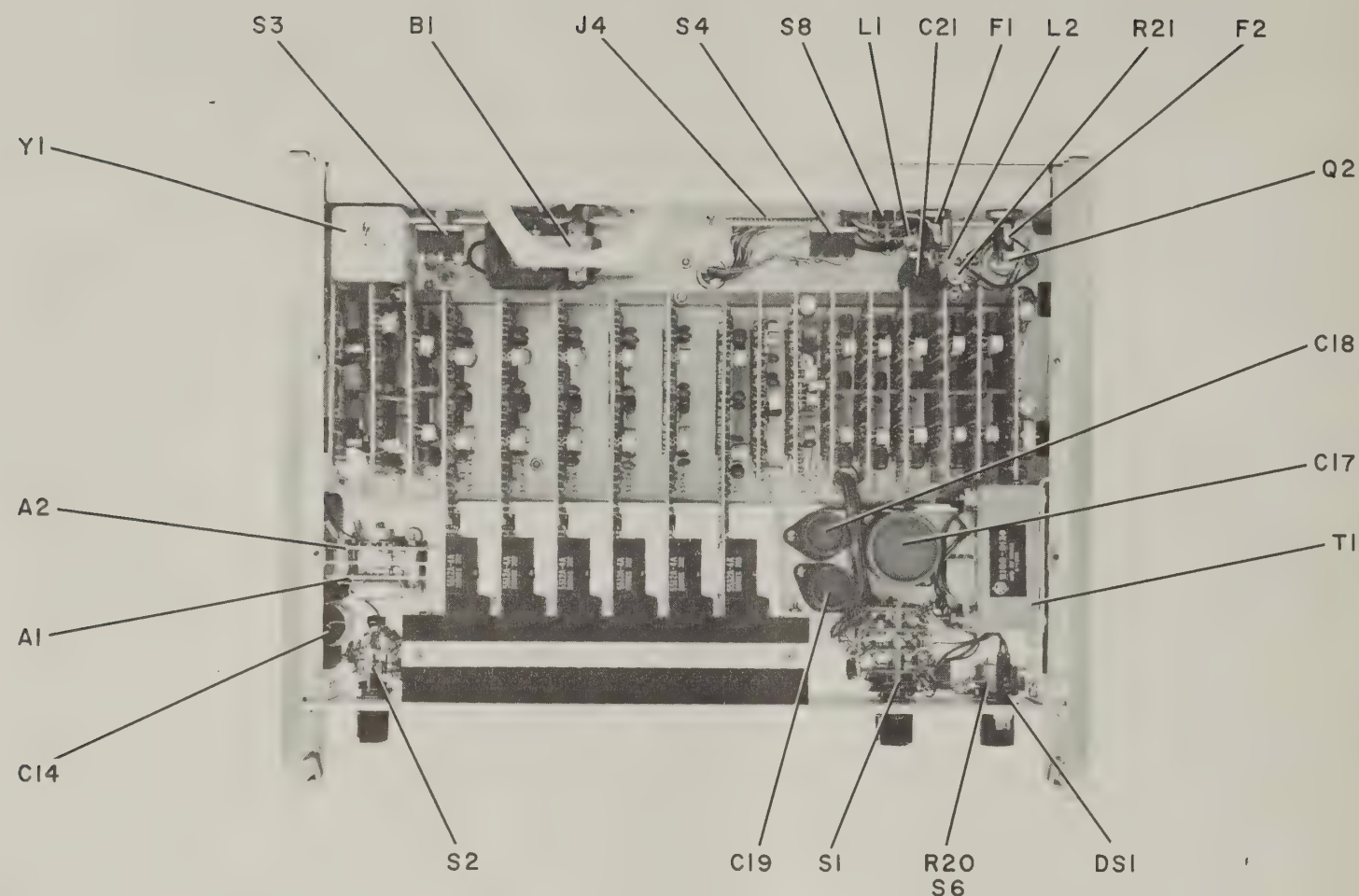


Figure 5-1. 5232A Component Location



05232-A-10

Figure 5-2. 5532A Component Location

i. If frequency difference is excessive for the desired application of Counter, see paragraph 5-27 for time-base oscillator frequency adjustment procedure.

j. Note and record environmental temperature.

k. Repeat above steps a through h at interval of one month with environmental temperature as noted in step j. Change in frequency difference between standard frequency and time-base oscillator frequency is frequency drift of time-base oscillator. Drift should not exceed ± 3 parts in 10^7 in one month interval.

5-17. ADJUSTMENTS.

5-18. POWER SUPPLY.

- Set line voltage to normal value (115 or 230 vac).
- Connect DC Voltmeter (see table 5-1) to A19 (15).
- Voltmeter should read $-35 \text{ vdc} \pm 1 \text{ vdc}$. If voltage is outside of this range, adjust A19R7 (-35 volt adjust; see figure 5-1 or 5-2) to obtain -35 vdc .
- Vary line voltage from 103 to 127 vac (207 to 253 vac). The -35 vdc supply should not vary more than 0.5 vdc .
- Check all supply voltages at locations, and under conditions shown in table 5-2. Note that only the -35 vdc supply is adjustable.

Table 5-2. Power Supply Voltage

Test Point	Line Voltage			Adjustment
	103	115	127	
A19(15)	-35 ± 1 Ripple + noise	-35 ± 1 .2 v p/p	-35 ± 1	A19R7
A19(3)	-135 ± 10	-150 ± 10	-165 ± 10	None
A19(14)	$+135 \pm 10$	$+150 \pm 10$	$+165 \pm 10$	None
A19(12)	-26.5 ± 1	-26.5 ± 1	-26.5 ± 1	None
A19(13)	-2.5 ± 0.5	-2.5 ± 0.5	-2.5 ± 0.5	None

5-19. INPUT SCHMITT TRIGGER.

5-20. Paragraphs 5-21, 5-22, and 5-23 below are procedures to test input Schmitt trigger assembly A2 to proper operation. If any test is not passed, see paragraph 5-24 for trigger adjustment procedure.

5-21. 10 CPS TO 1.2 MC CHECK.

a. Connect test Oscillator to INPUT of counter. Set Oscillator output to 10 cps, 10 mv.

b. Connect Oscilloscope to output of A2. Oscilloscope display should be a rectangular wave, approximately 40% positive and 60% negative.

c. Sweep frequency of Test Oscillator from 10 cps to 1.2 mc.

d. Oscilloscope display should remain a jitter-free rectangular wave at any frequency between 10 cps and 1.2 mc.

5-22. 2 CPS TO 10 CPS CHECK.

a. Disconnect Test Oscillator and connect Low Frequency Generator. Set Generator output to 2-cps, 100-mv rms sine wave.

b. Sweep frequency of Generator from 2 cps to 10 cps.

c. Oscilloscope display should remain a jitter-free rectangular wave at any frequency between 2 cps and 10 cps.

5-23. ADJUSTMENT FOR SINE WAVE OPERATION.

a. Connect 100-kc sine wave, 100-mv rms, to INPUT.

b. Turn A2R2 (trigger level adjust; see figure 5-1 or 5-2) fully clockwise.

c. Turn A2R2 slowly counterclockwise until output of A2, as observed on the oscilloscope, is a stable rectangular waveform, approximately 40% positive and 60% negative.

d. Repeat procedures in paragraph 5-21, 5-22, and 5-23, readjusting A2R2 as necessary.

5-24. ADJUSTMENT FOR PULSE OPERATION.

Note

Optimum adjustment for pulse operation will differ from optimum sine wave adjustment. Use this adjustment only for pulse operation. Input Schmitt Trigger may be adjusted for either positive or negative pulse operation.

a. Connect Pulse Generator set for $1 \mu\text{sec}$, 1 volt pulses of desired polarity with repetition rate of 1 kc. (Connect generator with normal recommended load.)

b. Connect Oscilloscope to output of A2.

c. Adjust A2R2 until a stable $1 \mu\text{sec}$ pulse is displayed.

5-25. TIME BASE OSCILLATOR.

5-26. QUICK ACCURACY CHECK.

a. Connect a 1 mc signal from a standard frequency source to INPUT of Counter.

b. Adjust Counter controls (see figure 3-3) to measure the frequency of the standard signal using the 10 second gate time.

c. Counter should display 00.0000 kc (10 at left of number not displayed) if counter time base oscillator and 1 mc standard are at same frequency. Difference between counter reading and 1 mc standard is the frequency offset of counter time base oscillator in parts in 10^7 .

d. If offset is excessive for your applications, proceed with oscillator adjustment.

5-27. FREQUENCY ADJUSTMENT.

- Remove top cover of counter.
- Set function switch to MANUAL START.
- Set EXT-INT switch (on rear panel) to INT.
- Connect Oscilloscope to J2, STD BNC connector on rear panel.
- Trigger Oscilloscope externally with 100-kc signal from standard frequency source.
- Set Oscilloscope sweep time to 1 μ sec/cm. Adjust Oscilloscope controls to obtain a presentation of a rectangular wave, approximately 24 v p/p.
- Using a plastic tool, adjust C10, OSC FREQ (oscillator frequency adjustment; see figure 5-1 or 5-2), to stop any horizontal drift of the oscilloscope display. Drift of display in cm/sec is difference between standard frequency and the time-base oscillator frequency in parts in 10^6 .

5-28. TROUBLESHOOTING AND REPAIR.

5-29. SELF-CHECK. When malfunction is suspected, disconnect all equipment from counter and perform self-check procedure given in figure 3-1. If counter does not self-check properly, see paragraph 5-30. If counter self-checks properly, check that all inputs to counter are within the limits of counter specifications. For example, the input signal may be intermittent or have a small signal-to-noise ratio. Damaged connecting cables may be causing noise or intermittent connections. If malfunction still occurs, cause is internal to counter. Make performance checks, (paragraph 5-11), to help determine source of trouble. Return to paragraph 5-30 for troubleshooting aids.

5-30. TROUBLESHOOTING AIDS. Table 5-4 lists the printed circuit assemblies that are checked during the self-check procedure (figure 3-1), with the corresponding positions of the function switch and the proper front panel display. Table 5-3 gives the reference designations of all printed circuit assemblies used in the counter and their corresponding nomenclatures. Table 5-5 gives information on waveforms which are present when circuits are operating properly. To use table 5-5, first set SENSITIVITY to CHECK, function switch to 10 SEC, EXT-INT to INT, and remove printed circuit assemblies A17 and A18 from counter. If assemblies A1 through A16, and A19, are checked and are operating properly, install A17 and A18, and refer to waveform chart in figure 5-4. Set counter controls as shown above waveform chart.

Table 5-3. Assembly Designations

A1	AMPLIFIER ASSEMBLY (INPUT)
A2	TRIGGER ASSEMBLY (INPUT, SCHMITT)
A3	DECIMAL COUNTER ASSEMBLY
A4	DECIMAL COUNTER ASSEMBLY
A5	DECIMAL COUNTER ASSEMBLY
A6	DECIMAL COUNTER ASSEMBLY
A7	DECIMAL COUNTER ASSEMBLY
A8	DECIMAL COUNTER ASSEMBLY
A9	OSCILLATOR ASSEMBLY (TIME BASE)
A10	DECADE DIVIDER ASSEMBLY
A11	DECADE DIVIDER ASSEMBLY
A12	DECADE DIVIDER ASSEMBLY
A13	DECADE DIVIDER ASSEMBLY
A14	DECADE DIVIDER ASSEMBLY
A15	DECADE DIVIDER ASSEMBLY
A16	DECADE DIVIDER ASSEMBLY
A17	GATE CONTROL ASSEMBLY
A18	DISPLAY CONTROL ASSEMBLY
A19	POWER SUPPLY ASSEMBLY

5-31. MODULE SUBSTITUTION. Maintenance procedures may be greatly simplified if troubleshooting is done by replacing an assembly suspected of malfunction with a spare assembly known to be operating correctly. When malfunctioning assembly is found, trouble then may be traced to the individual components responsible for the malfunction, or the assembly may be shipped to your Hewlett-Packard Field Office for repair.

5-32. TROUBLESHOOTING OF ASSEMBLIES. Refer to section IV, Principles of Operation, for information on the operation of circuits. Consult the component location figures, signal waveforms, and voltages which are included with the assembly schematics at the rear of this section. Use the printed circuit assembly extension board provided with each instrument to obtain easy access to assembly circuits during operation.

5-33. PRINTED CIRCUIT COMPONENT REPLACEMENT. Component lead-holes in the Model 5232A/5532A circuit boards have plated walls to ensure good electrical contact between conductors on the opposite sides of the board. To prevent damage to

Table 5-4. Self-Check Troubleshooting Aid

Circuits Checked During Self-Check Procedure (see figure 3-1)																					
		Assemblies Being Checked																			
Function Switch Position	Display	A1	A2	A3	A4	A5	A6	A7	A8	A9 *	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	
10 period	00.0010	x	x	x						x								x	x	x	
100	0.00100	x	x	x	x					x	x	x						x	x	x	
1K	001.000	x	x	x	x	x				x	x	x	x					x	x	x	
10K	01.0000	x	x	x	x	x	x			x	x	x	x	x				x	x	x	
100K	1.00000	x	x	x	x	x	x	x		x	x	x	x	x	x			x	x	x	
.01 sec	00100.0	x	x	x	x	x				x	x	x	x	x				x	x	x	
.1	0100.00	x	x	x	x	x	x			x	x	x	x	x	x			x	x	x	
1.	100.000	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x	x	x	
10.	00.0000	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Manual Start	Continuous 10 cps Counting	x	x			**				x	x	x	x	x	x			x	x	x	
Manual Stop	Continuous display of last count of manual start																	x	x	x	
* Only circuit operation checked; not accuracy or stability																					
**Depends on length of time in this position																					





this plating and to the replacement component, apply heat sparingly and work carefully. The following replacement procedure is recommended:

- Remove defective component.
- Melt solder in component lead-holes. Use clean dry soldering iron to remove excess solder. Clean holes with toothpick or wooden splinter. Do not use metal tool for cleaning as this may damage through-hole plating.
- Bend leads of replacement component to the correct shape and insert component leads into component lead-holes. Using heat and solder sparingly,

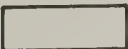







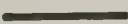





solder leads in place. Heat may be applied to either side of board. A heat sink (longnose pliers, commercial heat-sink tweezers, etc) should be used when replacing transistors and diodes in order to prevent excessive heat from being conducted by the leads from the soldering iron to the component.

- Through-hole plating breaks are indicated by the separation from the board of the round conductor-pad on either side of the board. To repair breaks, press conductor-pads against board and solder replacement component lead to conductor-pad on both sides of the board.

Table 5-5. Troubleshooting Aid

To use this table, set:		function switch01 SEC SENSITIVITY 0.1 VOLT RMS EXT-INT INT INPUT 1 mc 100 mv			DISPLAY maximum ccw Remove A17 and A18 from counter
To Check	Connect Oscilloscope to	Shape	Proper Indication Frequency	Approximate Amplitude v p/p	
Time Base A9	XA9(1)		1 mc	24	
Decade Divider Assembly A10 A11 A12 A13 A14 A15 A16	XA10(13) XA11(5) XA12(5) XA13(5) XA14(5) XA15(5) XA16(5)		100 kc 10 kc 1 kc 100 cps 10 cps 1 cps 0.1 cps	24 24 24 24 24 24 24	
Input Amplifier and Schmitt Trigger A1 A2	XA3(7)		100 kc	25	
Decimal Counter Assembly A3 A4 A5 A6 A7 A8	XA3(10) XA4(10) XA5(10) XA6(10) XA7(10) XA8(10)		100 kc 10 kc 100 cps 10 cps 1 cps 0.1 cps	29 29 29 29 29 29	
Gate Control Assembly A17 Display Control Assembly A18	See waveforms on figure 5-1, waveform chart				

SCHEMATIC DIAGRAM NOTES

	Front panel designation.		Power line ground
	Rear panel designation.		Circuit common ground
	Knob associated with a control.		Test point
	Screwdriver adjust		AND gate
	Main signal path		Inhibit gate
	Feedback path		OR gate
	Conducting element		
	Wiper moves toward "cw" when control is rotated clockwise		

Waveforms shown are typical.

Switch Designation:

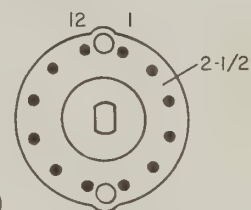
Example: A3S1BR (2-1/2)

A3S1
Switch S1
Within
Assy A3

B
2nd Wafer
From Front
(A = 1st, etc)

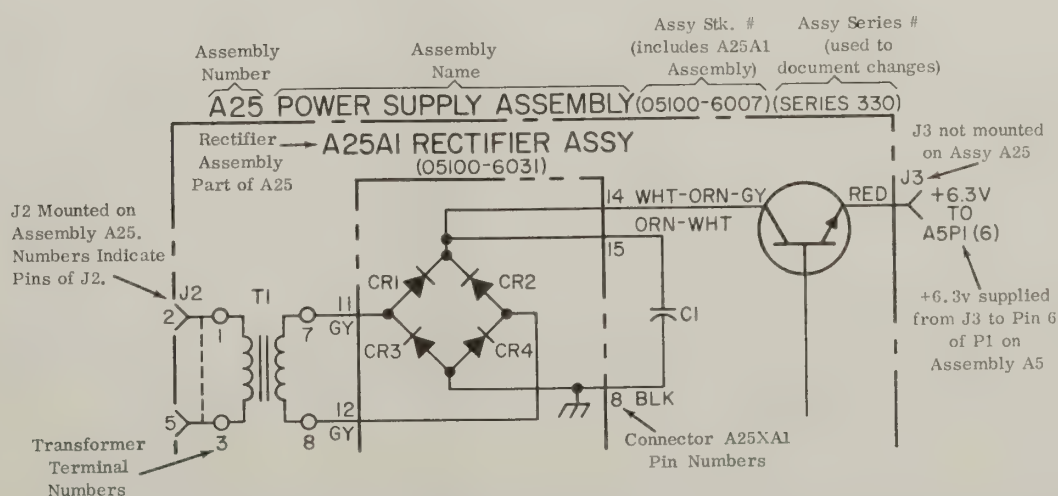
R
Rear Of
Wafer
(F = Front)

(2-1/2)
Terminal
Location 2-1/2
(Viewed From Front)



Reference designations within assemblies have been abbreviated. To form complete designations add assembly designation to the abbreviated designation shown (see illustration below).

Examples:	Assembly Designation	Abbreviated Reference Designation	Complete Reference Designation
	A25	C1	A25C1
	A25	J2	A25J2
	A25A1	CR1	A25A1CR1
	No Prefix	J3	J3



00000-B-20

NOTES

- 1. THE FIGURE NUMBER WITHIN EACH SECTION IDENTIFIES THE SCHEMATIC DIAGRAM FOR THAT SECTION
- 2. $RATIO = \frac{f_1}{f_2} \times PERIOD \ MULTIPLIER$
- 3. NUMBERS NEAR DASHED BORDER LINES INDICATE PIN NUMBERS OF ASSEMBLIES

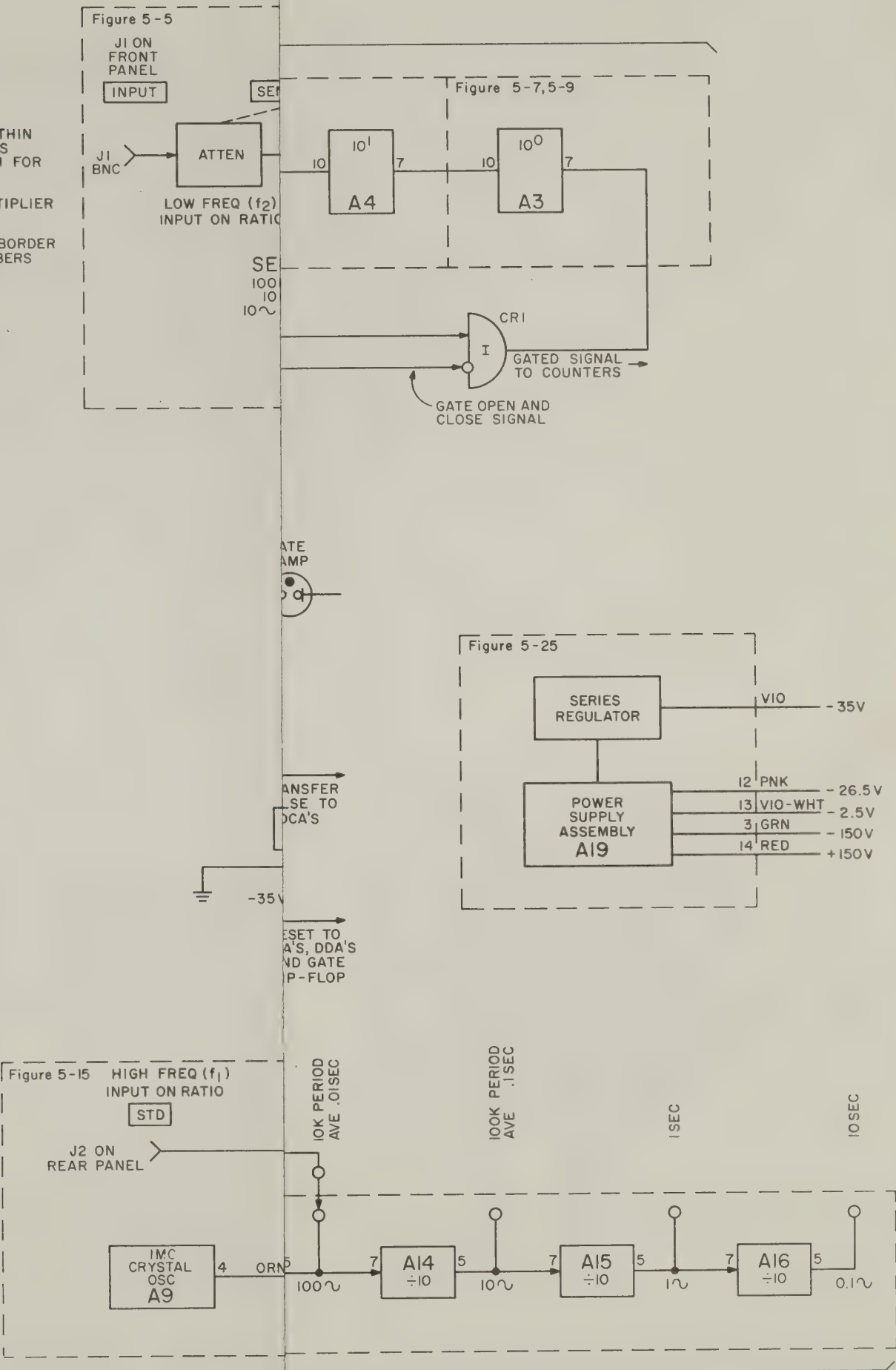


Figure 5-3. Functional Block Diagram

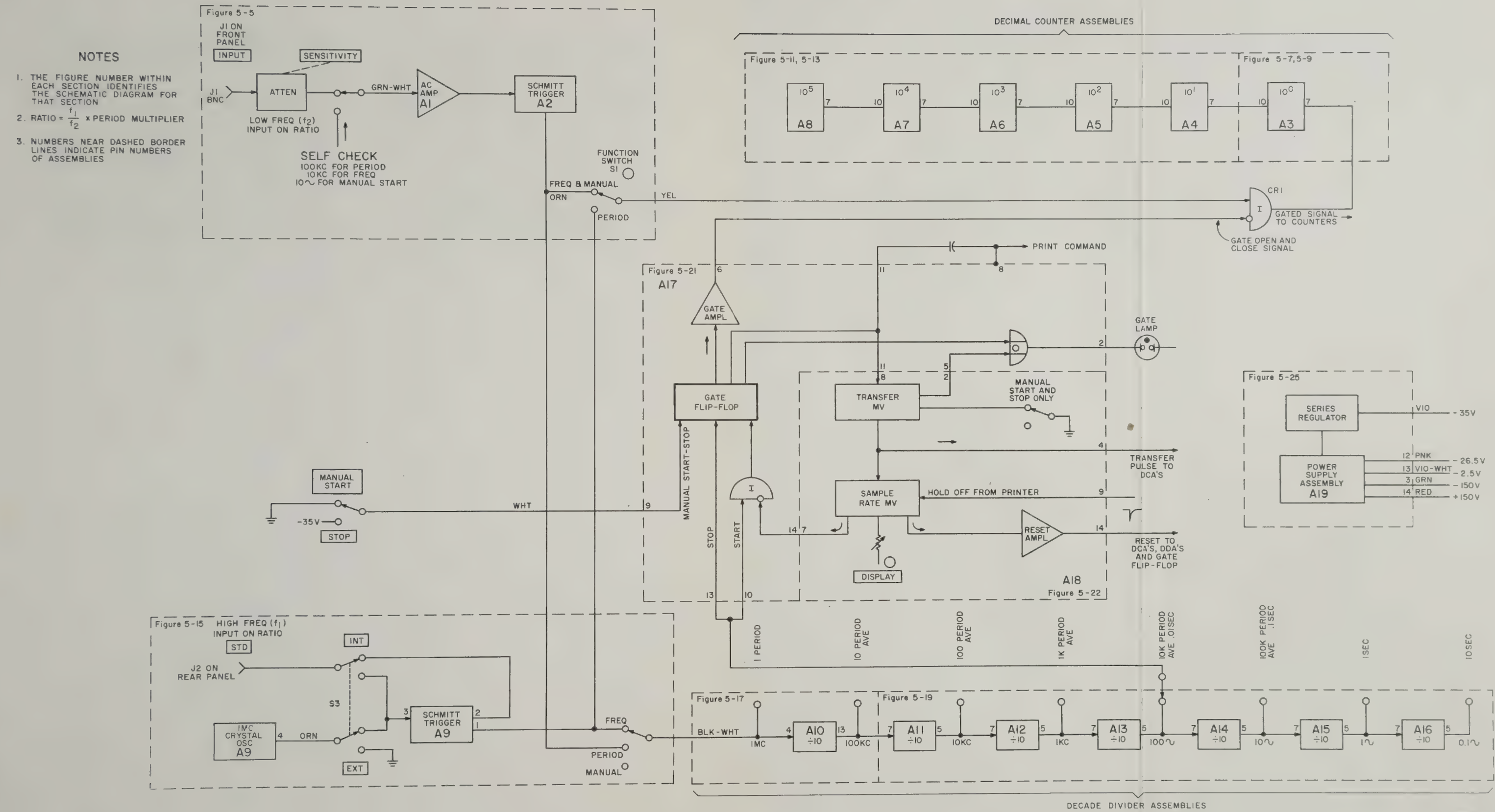


Figure 5-3. Functional Block Diagram

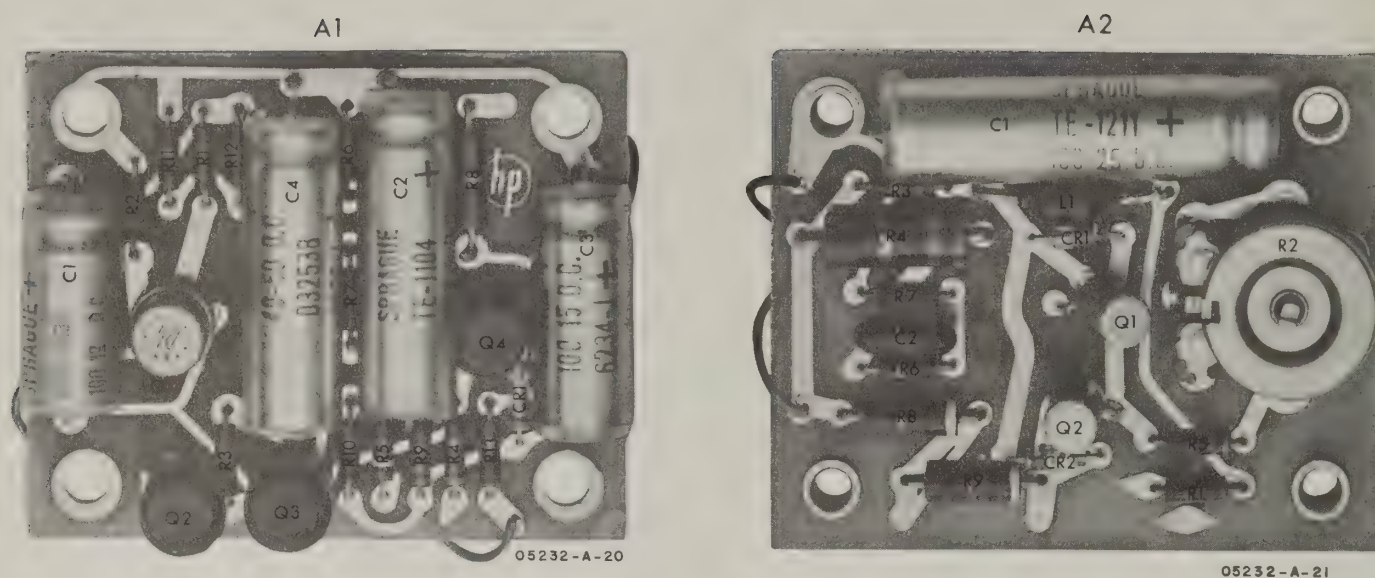


Figure 5-5. A1, A2, Component Location

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS
INDUCTANCE IN MICROHENRIES

REFERENCE DESIGNATIONS

NO PREFIX	A1	A2
C4,6-9, 11-14	C1-4 CR1	C1,2 CR1,2 LI
R2-9, 11-15 SI,2	Q1-4 R1-13	Q1 R1-9

05232-D-14

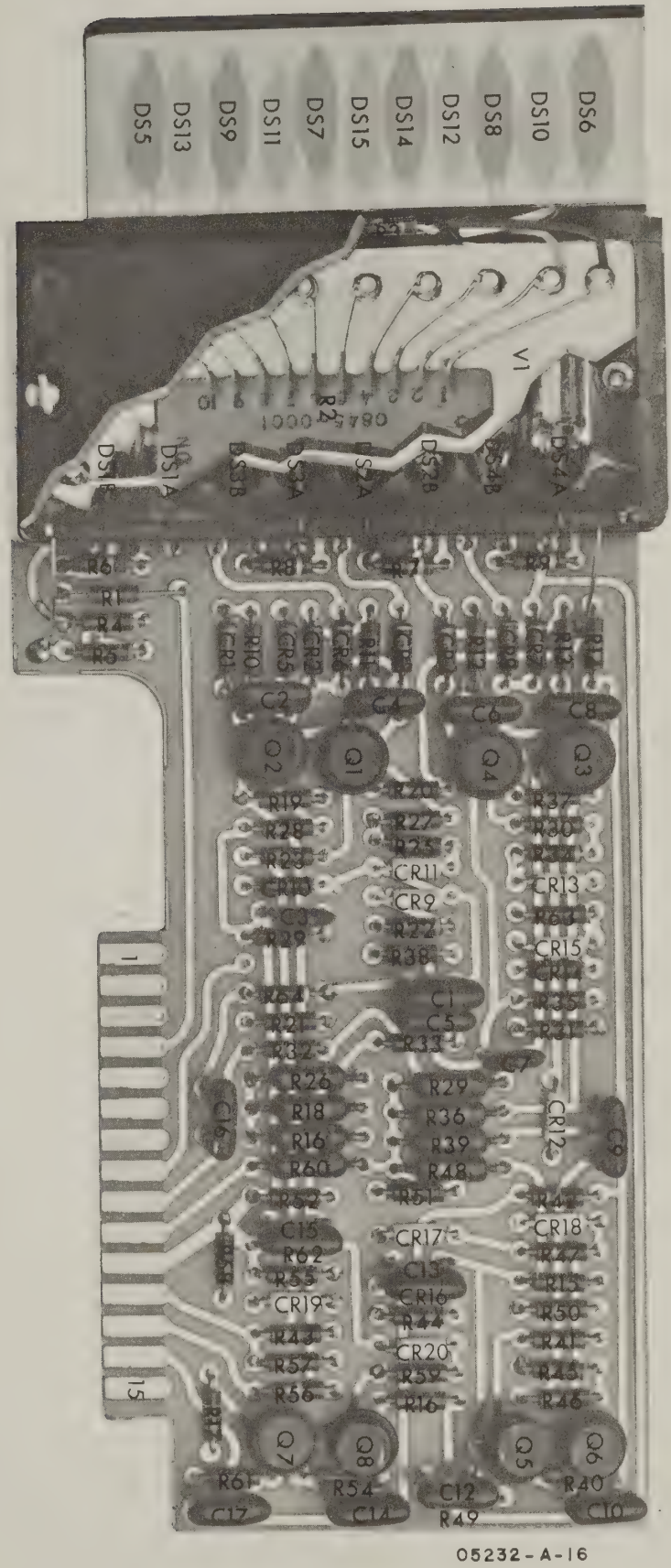


Figure 5-7. Component Location A3

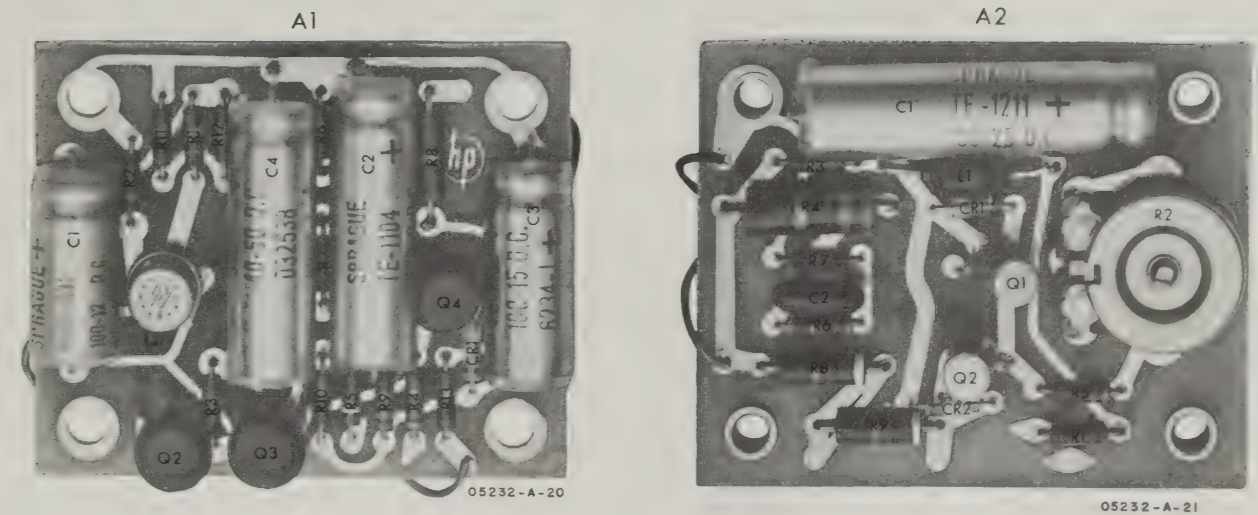
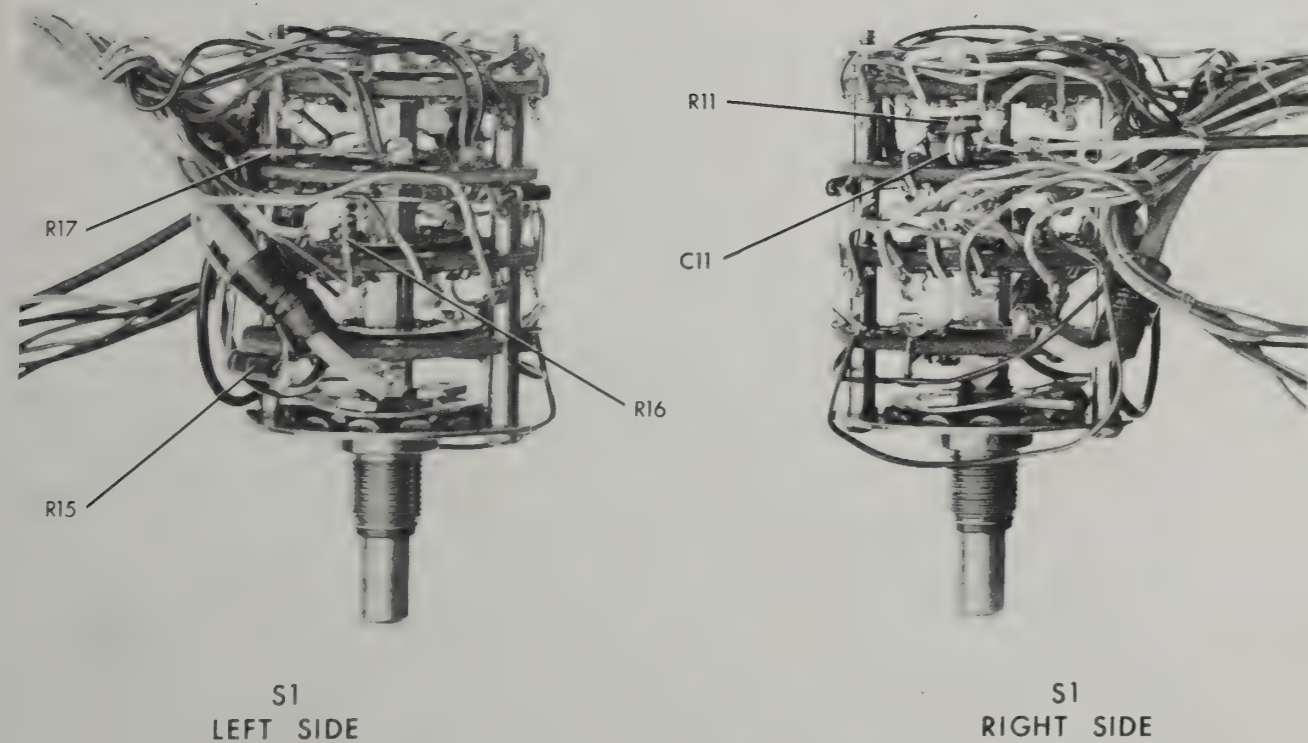
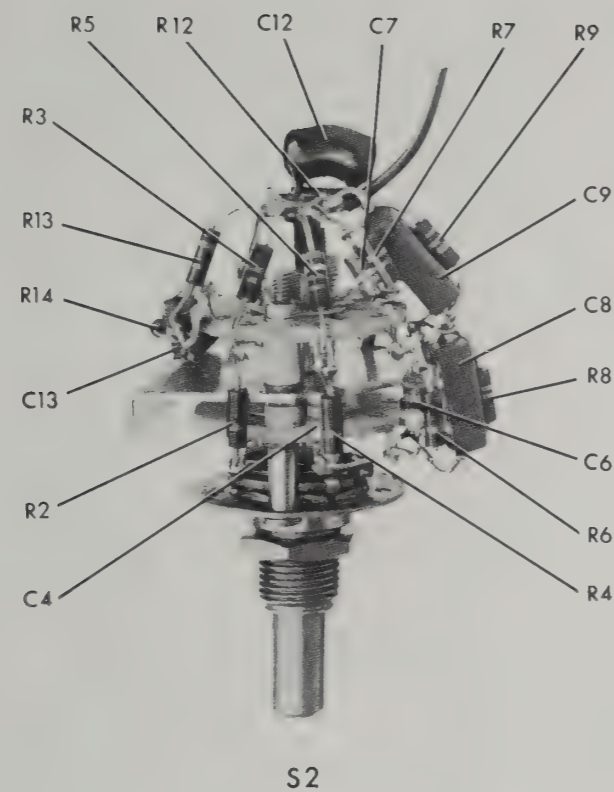


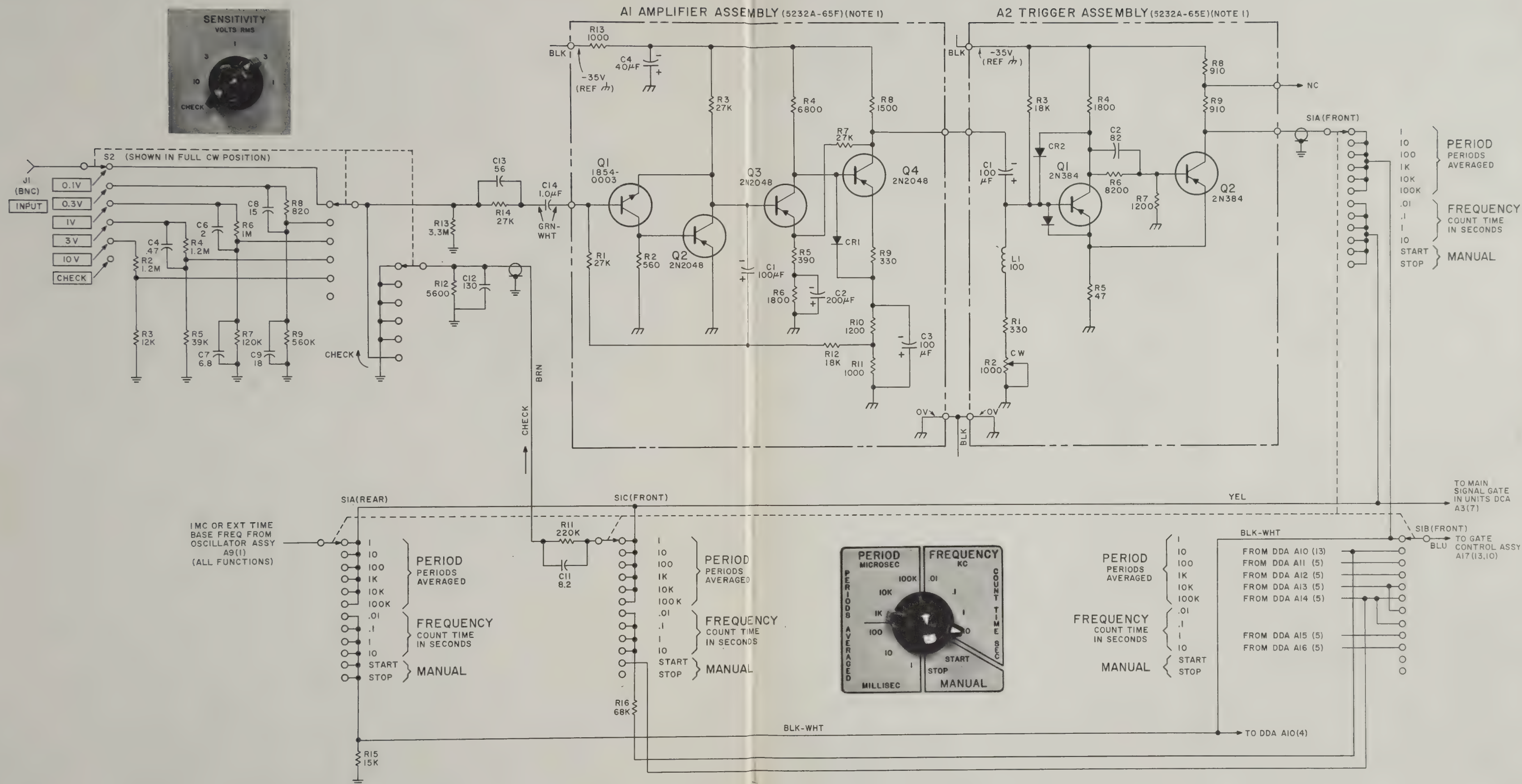
Figure 5-5. A1, A2, Component Location

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS
INDUCTANCE IN MICROHENRIES

REFERENCE DESIGNATIONS

NO PREFIX	A1	A2
C4,6-9, 11-14	C1-4	C1,2
	CR1	CR1,2
	Q1-4	L1
R2-9, 11-15	R1-13	Q1
S1,2		R1-9



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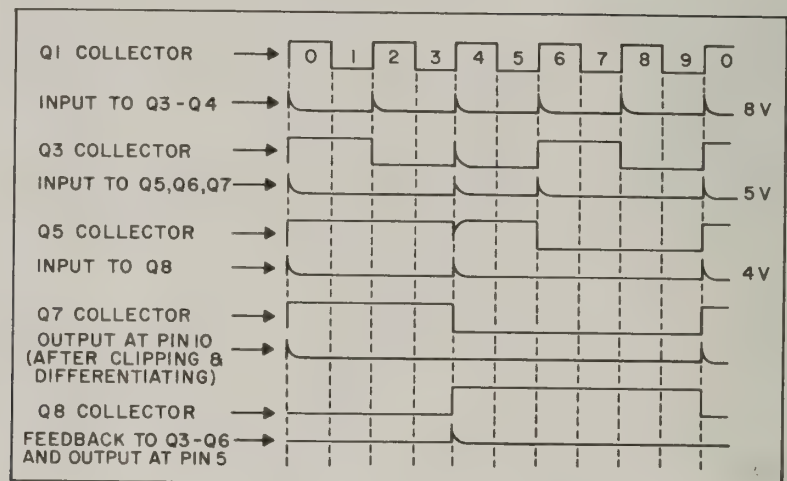
05232-D-11

Figure 5-6. Amplifier Assembly A1 and Trigger Assembly A2

NOTES

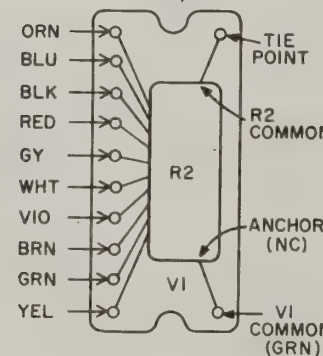
1. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS
2. REFERENCE DESIGNATIONS IN PARENTHESES
INDICATE LIGHT DESTINATION FOR DS1-DS4
LIGHT SOURCE IS NOTED NEAR EACH VI
SECTION
3. FILLED SQUARE (■) INDICATES CONDUCTING
ELEMENT FOR DECIMAL "0" (BCD "0000"); FOR
DS1-DS4, SECTION "A" LIGHTS ON "1"; SECTION
B LIGHTS ON "0"

WAVEFORMS



DIGIT	4 LINE CODE (0 = -, 1 = +)				RELEVANT STAGES				
	D	C	B	A					
					VI	BINARY			
						D	C	B	A
0	0	0	0	0	HPS				
1	0	0	0	1	DMR				
2	0	0	1	0	FNS				
3	0	0	1	1	BLR				
4	0	1	1	0	KQT				
5	0	1	1	1	JQT				
6	1	1	0	0	GPS				
7	1	1	0	1	CMR				
8	1	1	1	0	ENS				
9	1	1	1	1	ALR				

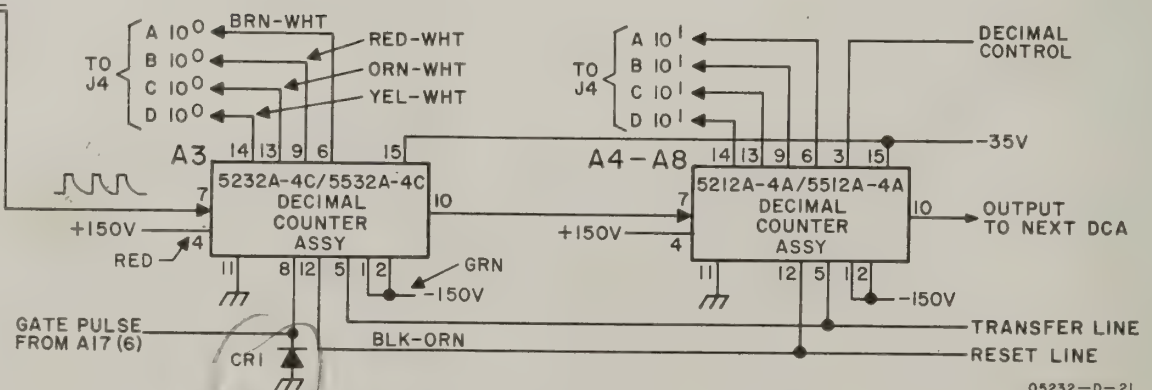
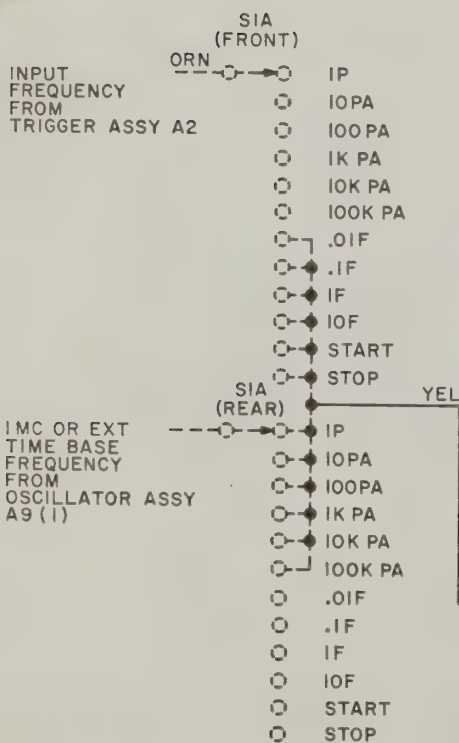
PHYSICAL LAYOUT

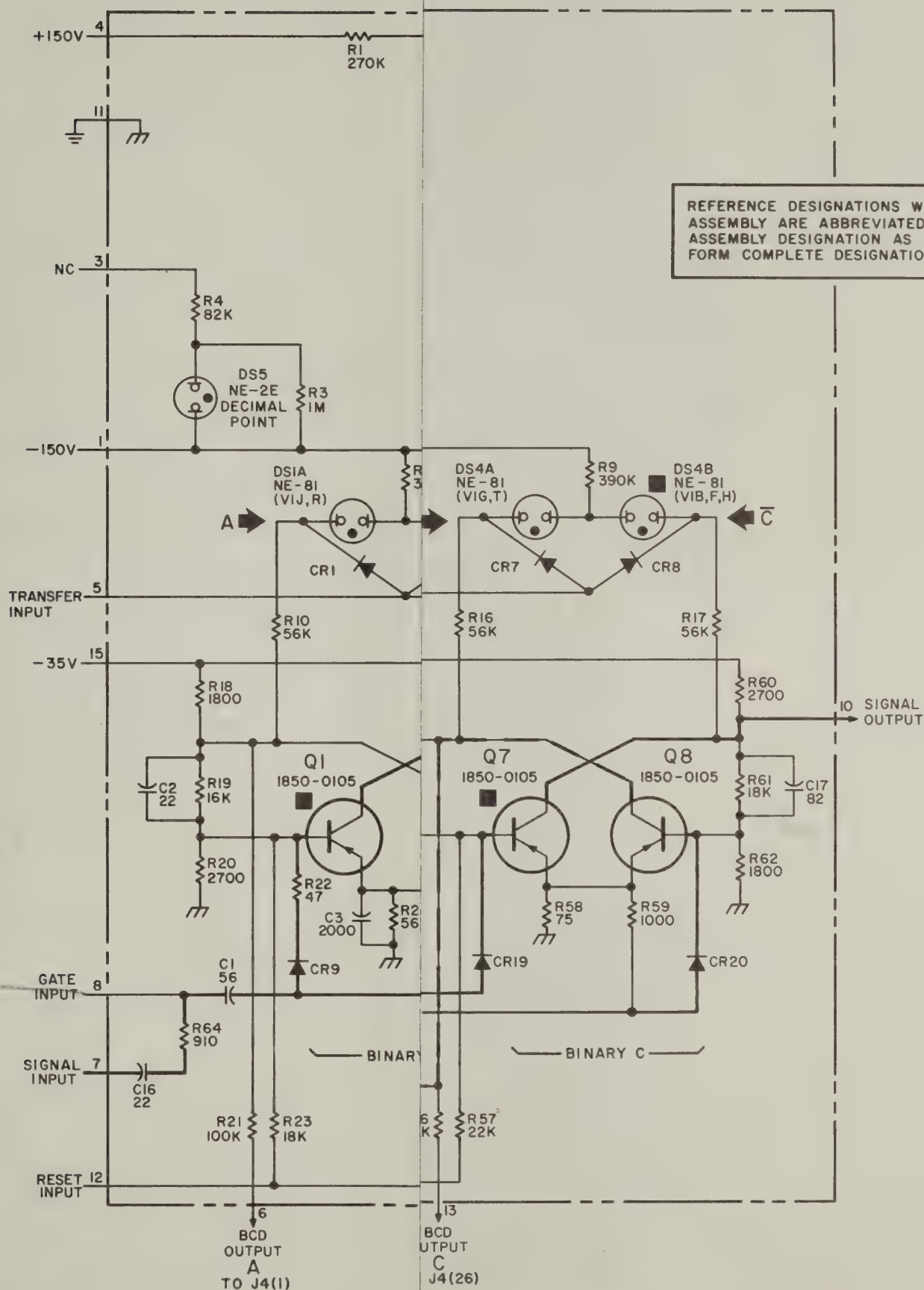
A. CONNECTION TO
R2, VIB. LAMP PHOTOCELL
MATRIX

C	VIT	DS4A
VIG		
VIF		
VIB		
B		
VIP		
VIM		
D		
VIL		
VIN		
D		
VIE		
VIA		
D		
VID		
VIO		
A		
VIR		
VIJ		
A		
VIK		
VIS		

REFERENCE DESIGNATIONS

CI - 16
CRI - 20
DS1 - 15
Q1 - 8
R1 - 64
VI





05232-D-22

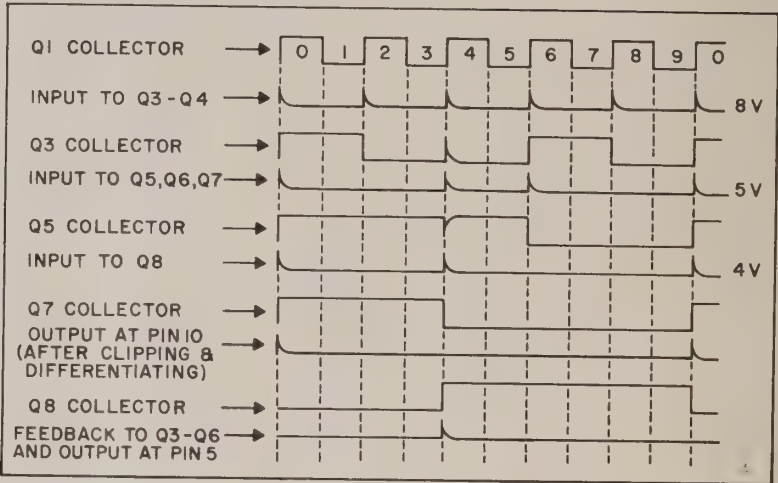
Figure 5-8. Decimal Counter Assembly A3 (5232A)

NOTES

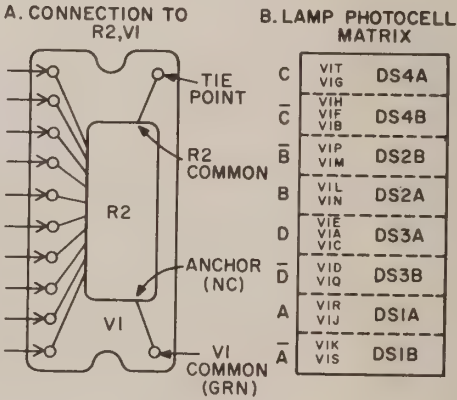
- 1. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS
- 2. REFERENCE DESIGNATIONS IN PARENTHESES
INDICATE LIGHT DESTINATION FOR DS1-DS4
LIGHT SOURCE IS NOTED NEAR EACH VI
SECTION
- 3. FILLED SQUARE (■) INDICATES CONDUCTING
ELEMENT FOR DECIMAL "0" (BCD "0000"); FOR
DS1-DS4, SECTION "A" LIGHTS ON "1," SECTION
B LIGHTS ON "0"

DIGIT	4 LINE CODE (0 = -, 1 = +)				RELEVANT STAGES				
	D	C	B	A	VI	D	C	B	A
0	0	0	0	0	HPS				
1	0	0	0	1	DMR				
2	0	0	1	0	FNS				
3	0	0	1	1	BLR				
4	0	1	1	0	KQT				
5	0	1	1	1	JQT				
6	1	1	0	0	GPS				
7	1	1	0	1	CMR				
8	1	1	1	0	ENS				
9	1	1	1	1	ALR				

WAVEFORMS

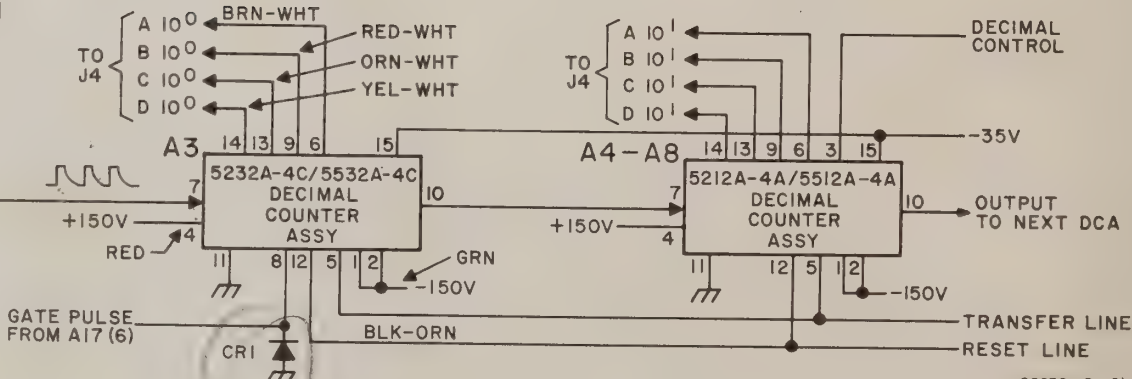
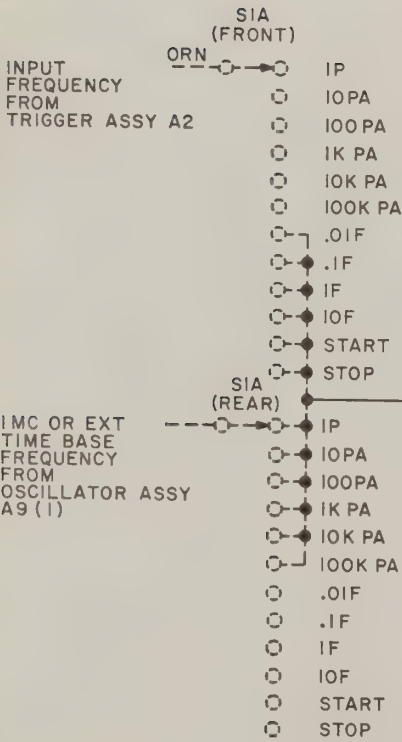


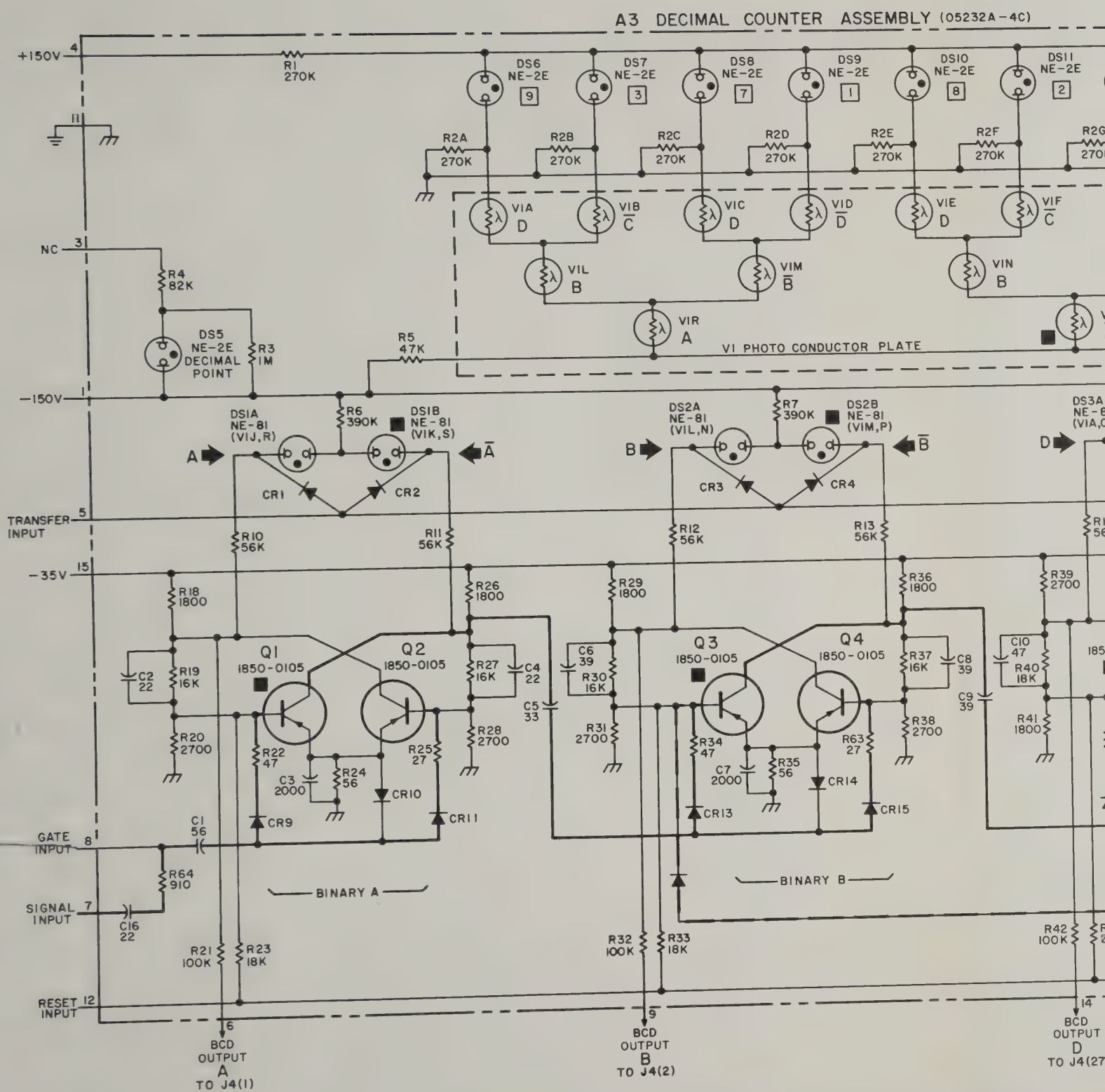
PHYSICAL LAYOUT



REFERENCE DESIGNATIONS

CI - 16
CR1 - 20
DS1 - 15
Q1 - 8
R1 - 64
VI

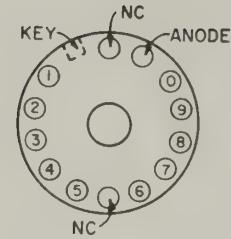




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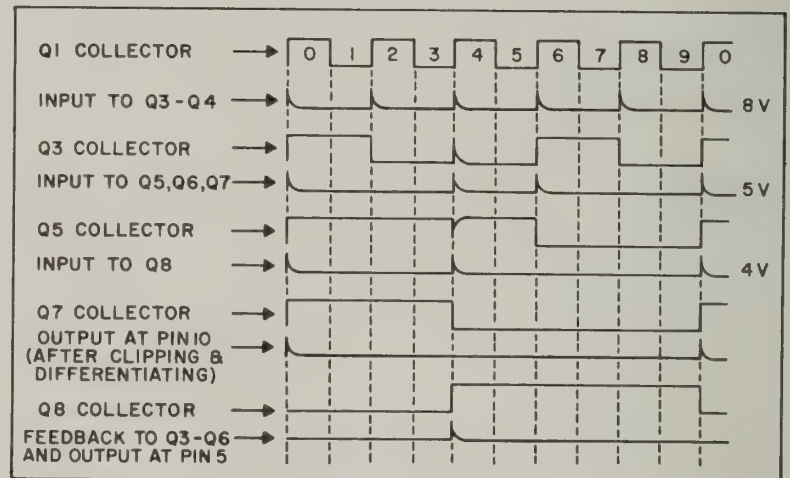
NOTES

- UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICO FARADS
- REFERENCE DESIGNATIONS IN PARENTHESES
INDICATE LIGHT DESTINATION FOR DS1-DS4
LIGHT SOURCE IS NOTED NEAR EACH VI
SECTION
- FILLED SQUARE (■) INDICATES CONDUCTING
ELEMENT FOR DECIMAL "0" (BCD "0000"); FOR
DS1-DS4, SECTION "A" LIGHTS ON "1", SECTION
B LIGHTS ON "0"

DIGITAL INDICATOR
PIN CONNECTIONS
(REAR VIEW)

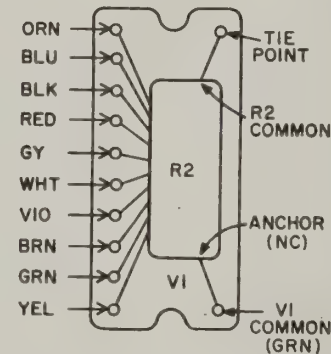
WAVEFORMS

DIGIT	4 LINE CODE (0 = -, 1 = +)				RELEVANT STAGES VI	BINARY			
	D	C	B	A		D	C	B	A
0	0	0	0	0	HPS				
1	0	0	0	1	DMR				
2	0	0	1	0	FNS				
3	0	0	1	1	BLR				
4	0	1	1	0	KQT				
5	0	1	1	1	JQT				
6	1	1	0	0	GPS				
7	1	1	0	1	CMR				
8	1	1	1	0	ENS				
9	1	1	1	1	ALR				



PHYSICAL LAYOUT

A. CONNECTION TO R2, VI

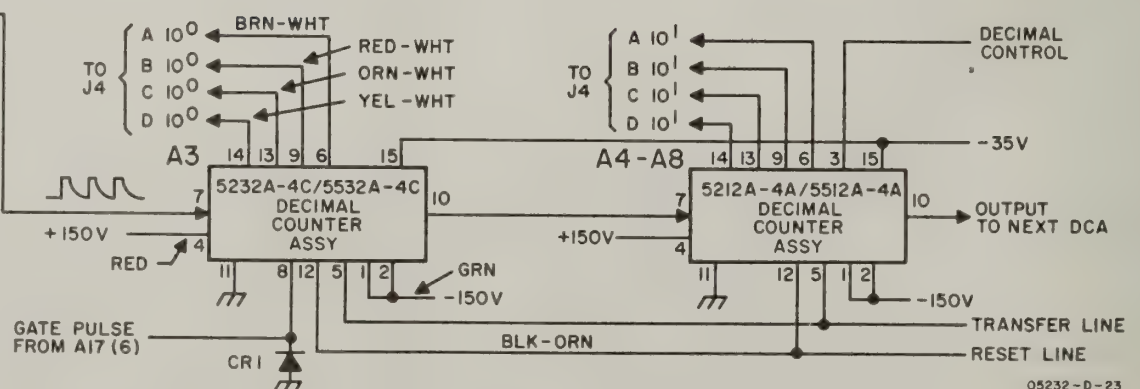
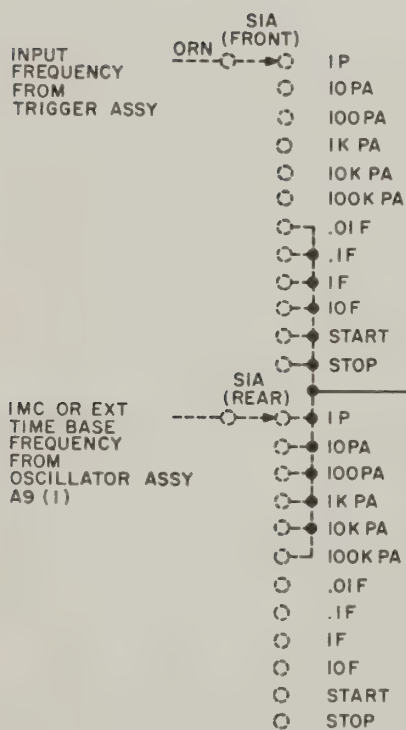


C	VI	DS
VIT	VIG	DS4A
VIH	VIF	DS4B
VIM	VIB	DS2B
VIL	VIM	DS2A
VIA	VIC	DS3A
VID	VIC	DS3B
VIA	VIC	DS1A
VIS	VIC	DS1B

REFERENCE DESIGNATIONS

CI - 16
CRI - 20
DS1 - 15
Q1 - 8
RI - 64
VI

OMITTED: R5



05232-D-23

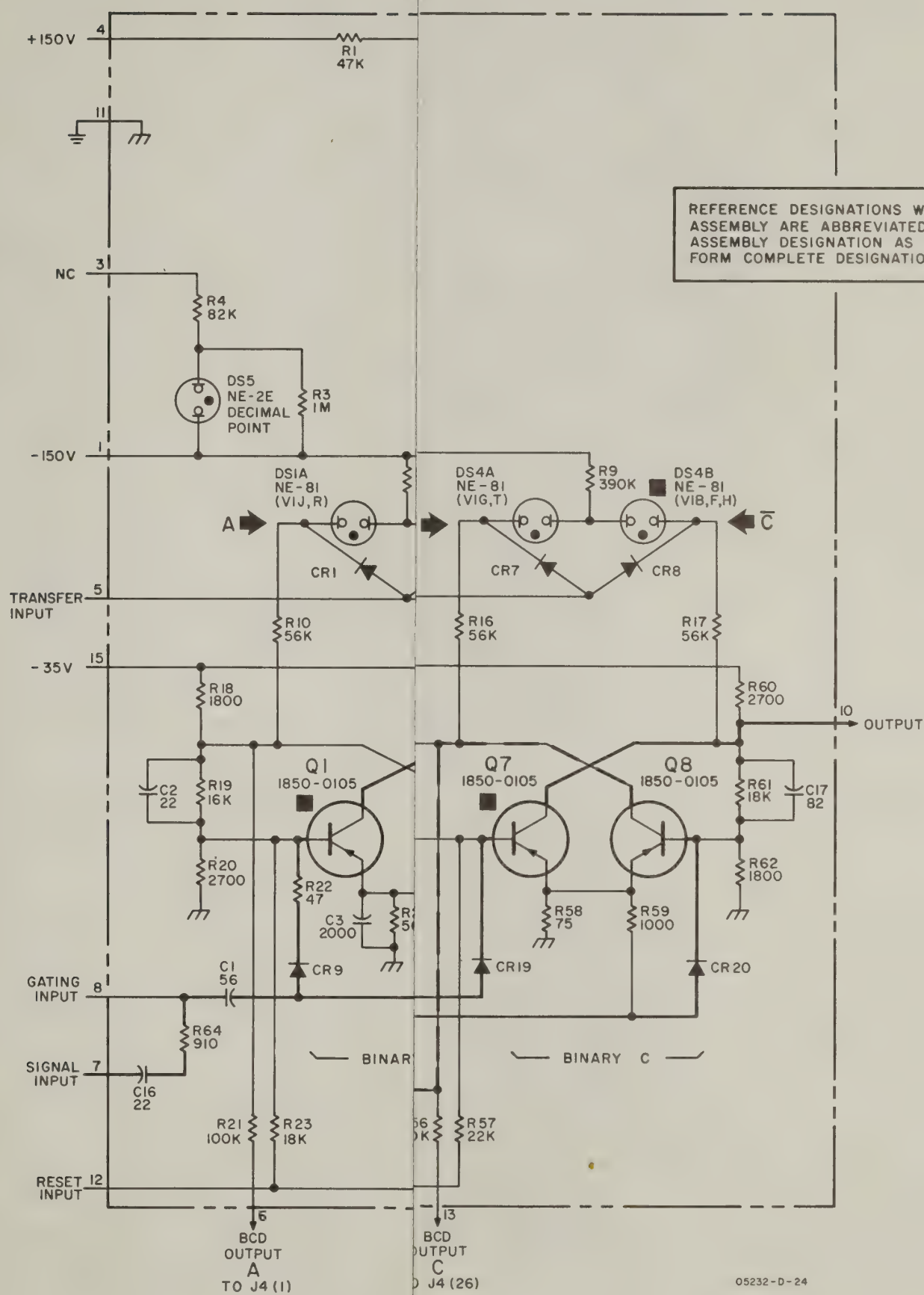


Figure 5-10. Decimal Counter Assembly A3 (5532A)

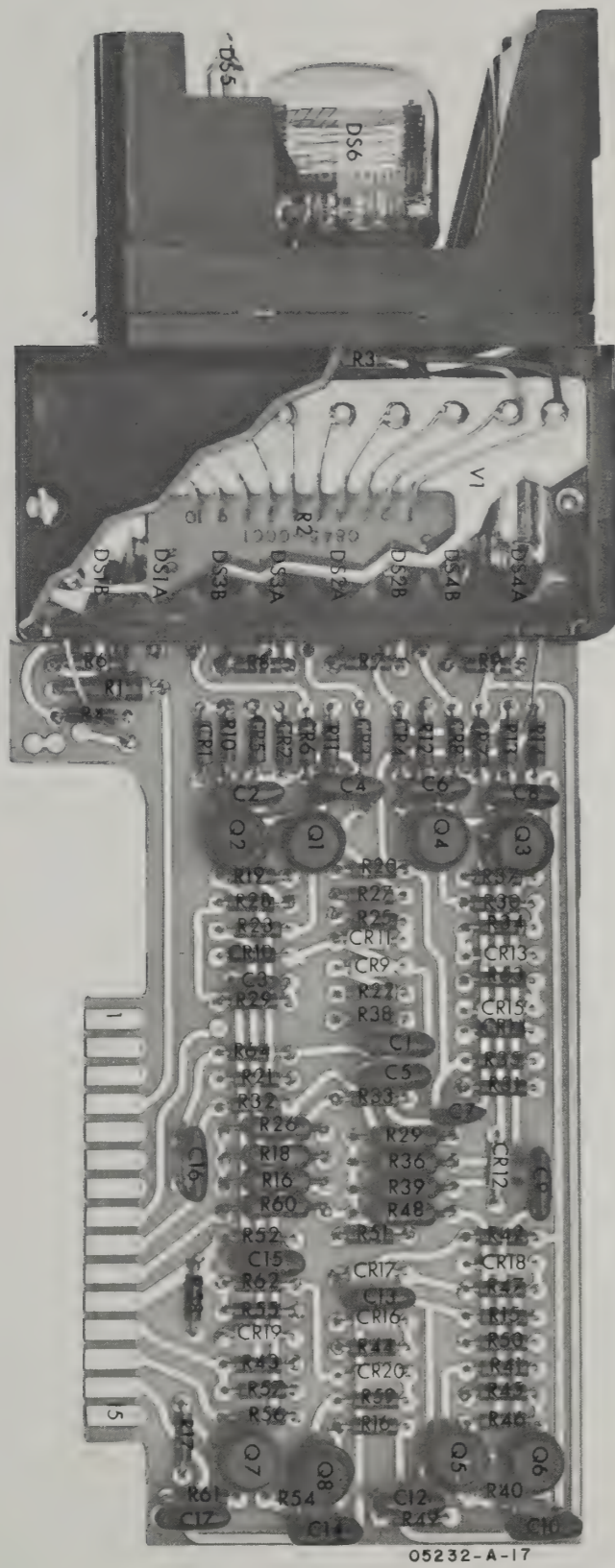
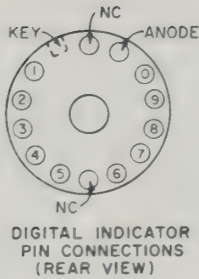


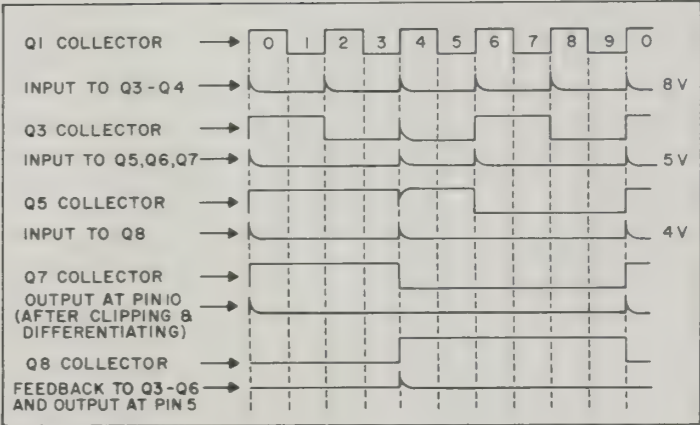
Figure 5-9. Component Location A3

NOTES

- 1. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICO FARADS
- 2. REFERENCE DESIGNATIONS IN PARENTHESES
INDICATE LIGHT DESTINATION FOR DS1-DS4
LIGHT SOURCE IS NOTED NEAR EACH VI
SECTION
- 3. FILLED SQUARE (■) INDICATES CONDUCTING
ELEMENT FOR DECIMAL "0" (BCD "0000"); FOR
DS1-DS4, SECTION "A" LIGHTS ON "I", SECTION
B LIGHTS ON "O"



WAVEFORMS

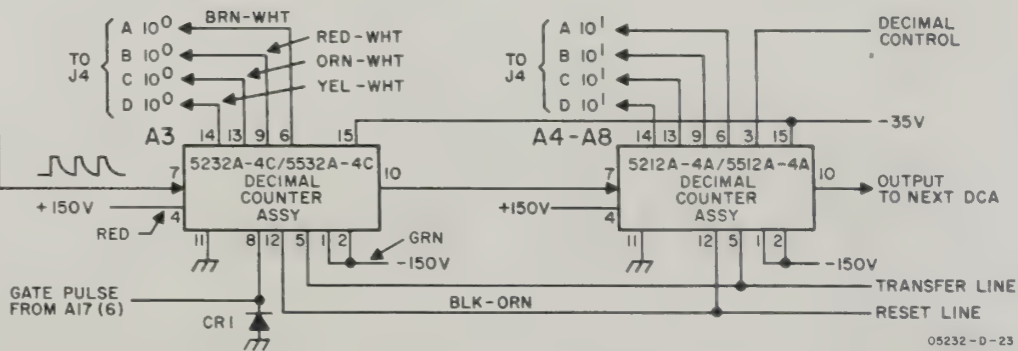
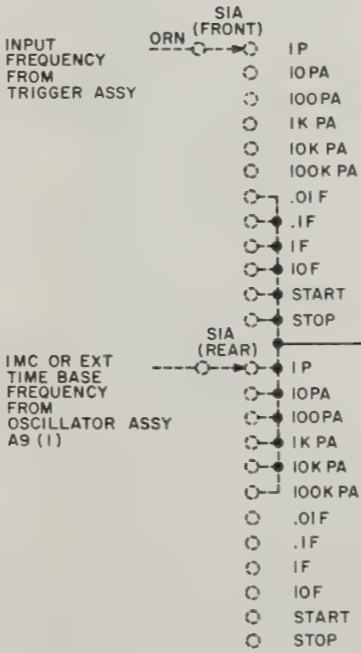


DIGIT	4 LINE CODE (0 = -, 1 = +)				RELEVANT STAGES				
					VI	BINARY			
	D	C	B	A			D	C	B
0	0	0	0	0	HPS				
1	0	0	0	1	DMR				
2	0	0	1	0	FNS				
3	0	0	1	1	BLR				
4	0	1	1	0	KQT				
5	0	1	1	1	JQT				
6	1	1	0	0	GPS				
7	1	1	0	1	CMR				
8	1	1	1	0	ENS				
9	1	1	1	1	ALR				

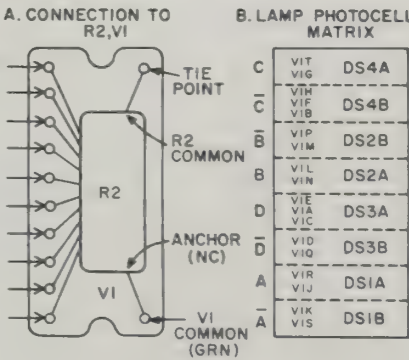
REFERENCE DESIGNATIONS

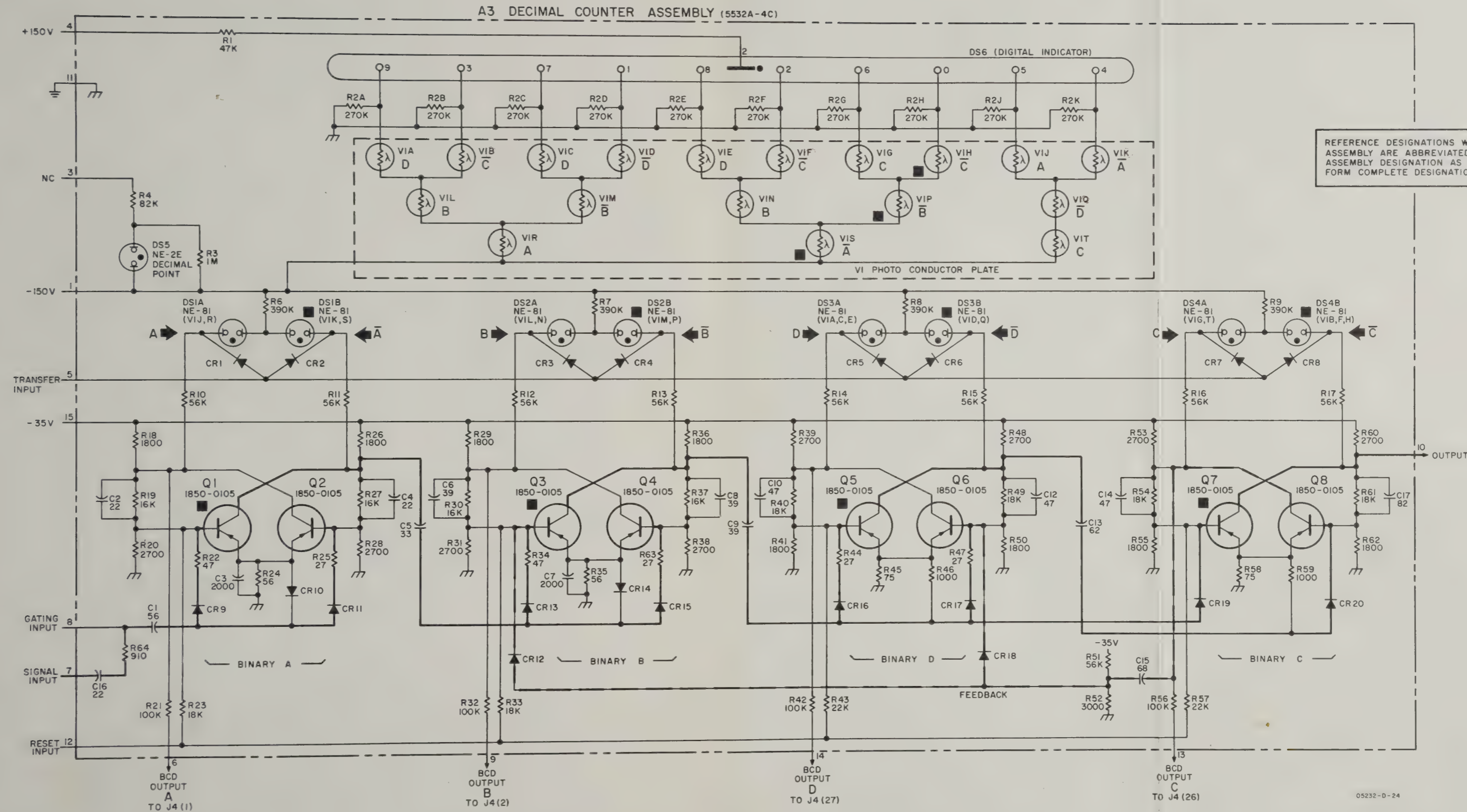
CI - 16
CR1 - 20
DS1 - 15
Q1 - 8
R1 - 64
VI

OMITTED: R5



PHYSICAL LAYOUT





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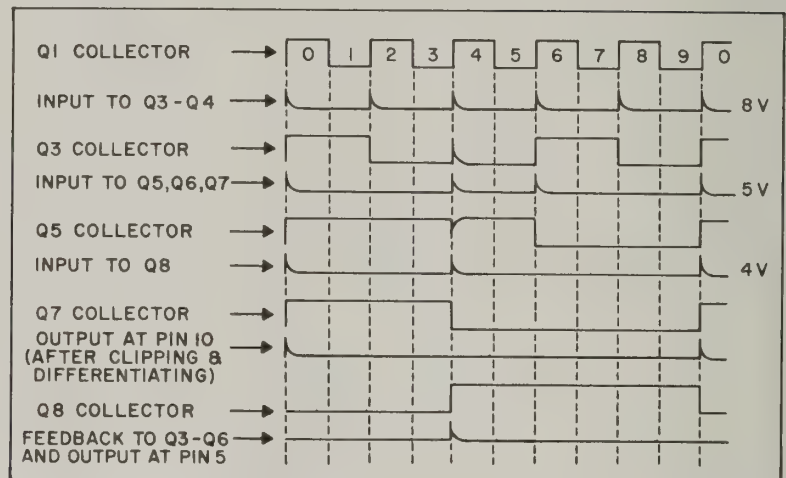
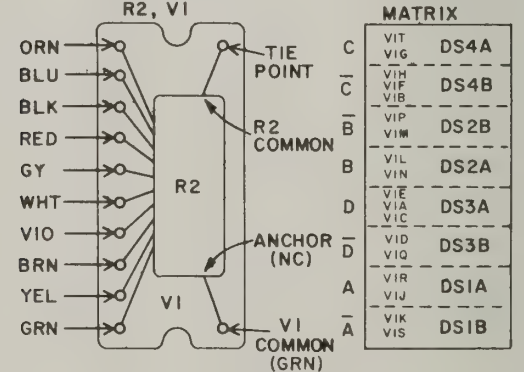
Figure 5-10. Decimal Counter Assembly A3 (5532A)

NOTES

1. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICO FARADS;
2. REFERENCE DESIGNATIONS IN PARENTHESES
INDICATE LIGHT DESTINATION FOR DS1-DS4
LIGHT SOURCE IS NOTED NEAR EACH VI
SECTION.
3. FILLED SQUARE (■) INDICATES CONDUCTING
ELEMENT FOR DECIMAL "0" (BCD "0000").
FOR DS1-DS4, SECTION A LIGHTS ON "1";
SECTION B LIGHTS ON "0"

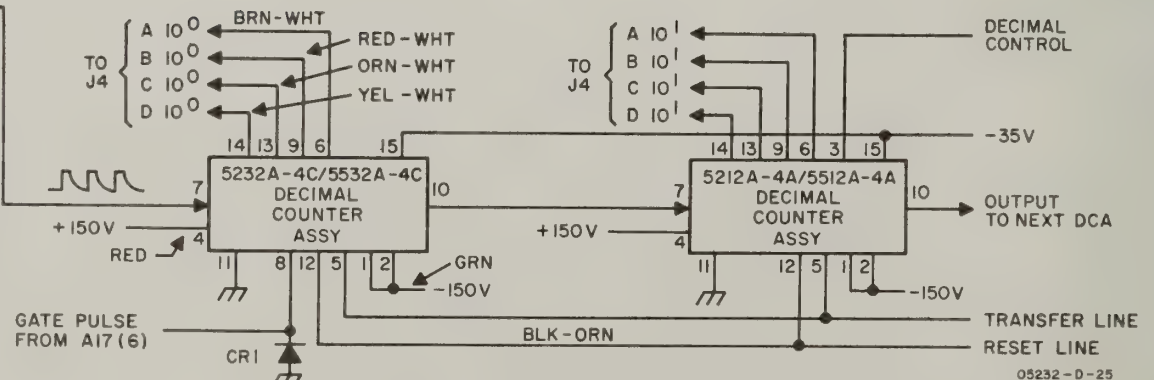
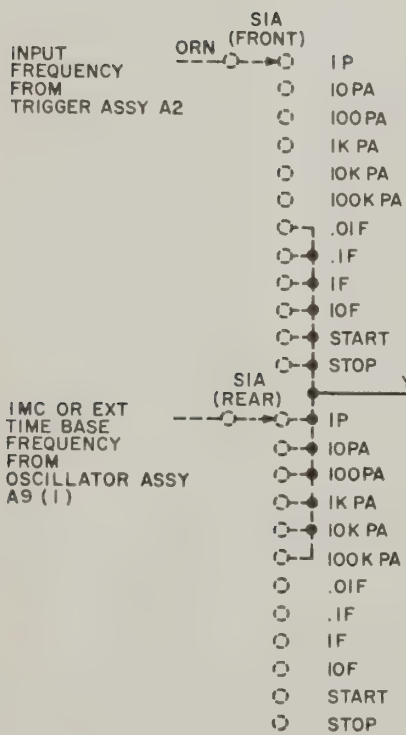
WAVEFORMS

DIGIT	4 LINE CODE (0 = -, 1 = +)				RELEVANT STAGES	BINARY			
	D	C	B	A		D	C	B	A
0	0	0	0	0	HPS				
1	0	0	0	1	DMR				
2	0	0	1	0	FNS				
3	0	0	1	1	BLR				
4	0	1	1	0	KQT				
5	0	1	1	1	JQT				
6	1	1	0	0	GPS				
7	1	1	0	1	CMR				
8	1	1	1	0	ENS				
9	1	1	1	1	ALR				

PHYSICAL LAYOUT
(PLATE 040-3)A. CONNECTION TO
R2, VIB. LAMP PHOTOCELL
MATRIX

REFERENCE DESIGNATIONS

A4 - A8
CI - 13
CR1 - 13
DS1 - 15
Q1 - 8
R1 - 62
VI



05232-D-25

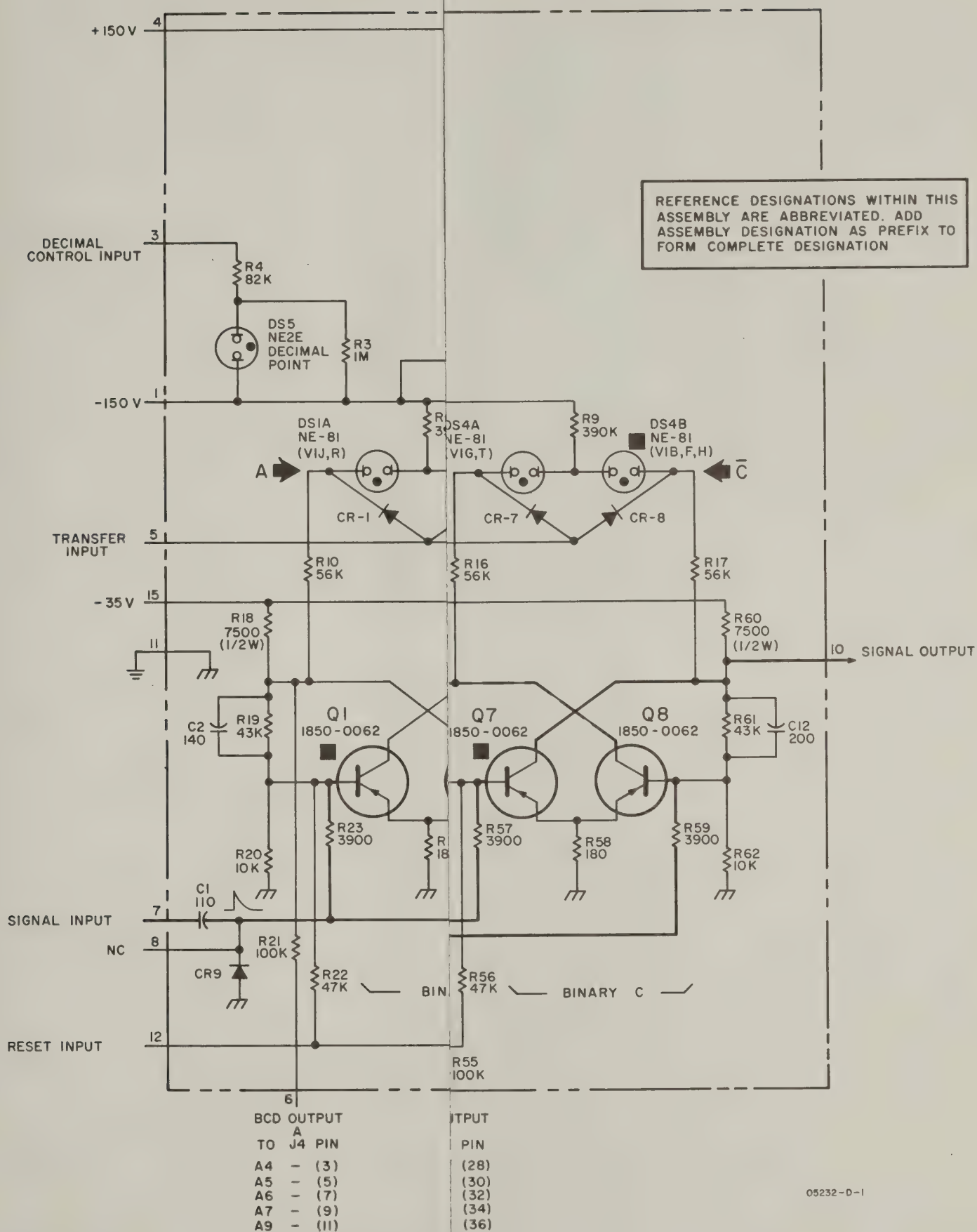


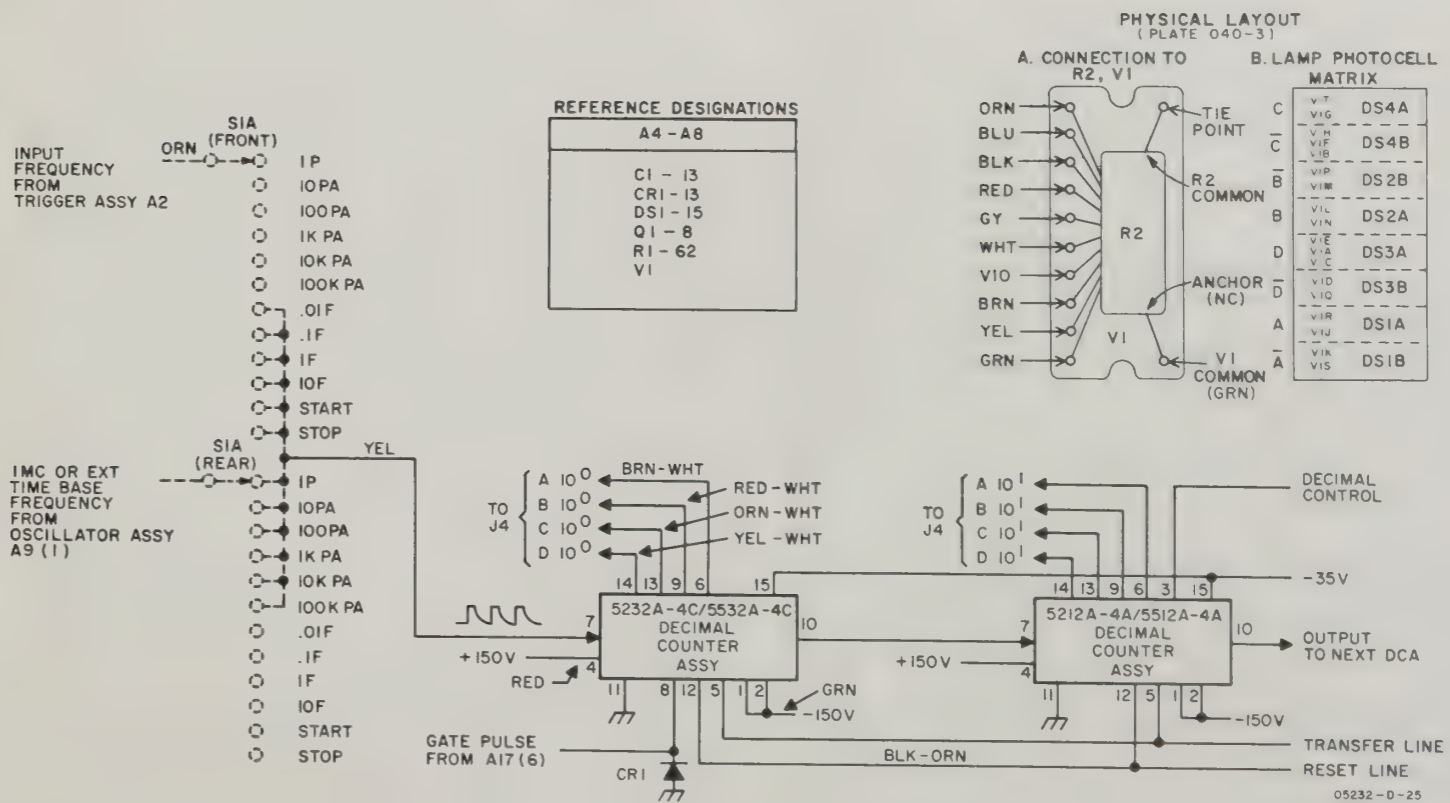
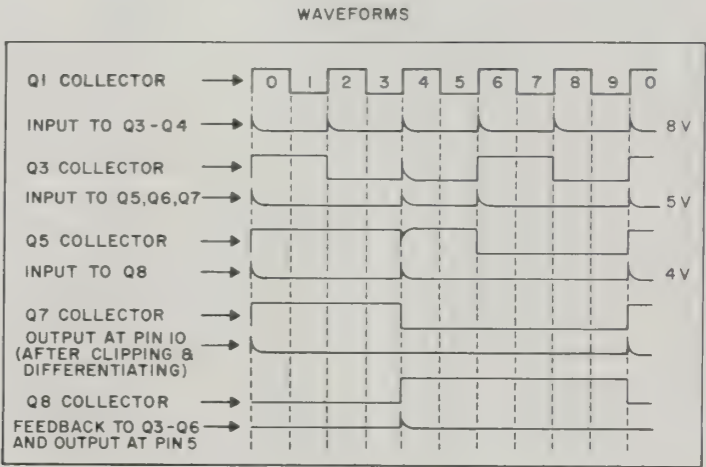
Figure 5-12. Decimal Counter Assemblies A4-A8 (5212A)



02017-1

1. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS;
2. REFERENCE DESIGNATIONS IN PARENTHESES
INDICATE LIGHT DESTINATION FOR DSI-DS4
LIGHT SOURCE IS NOTED NEAR EACH VI
SECTION.
3. FILLED SQUARE (■) INDICATES CONDUCTING
ELEMENT FOR DECIMAL "0" (BCD "0000").
FOR DSI-DS4, SECTION A LIGHTS ON "1";
SECTION B LIGHTS ON "0"

DIGIT	4 LINE CODE (0 = -, 1 = +)				RELEVANT STAGES				
					VI	BINARY			
	D	C	B	A			D	C	B
0	D	C	B	A	HPS				
1	0	0	0	1	DMR				
2	0	0	1	0	FNS				
3	0	0	1	1	BLR				
4	0	1	1	0	KQT				
5	0	1	1	1	JQT				
6	1	1	0	0	GPS				
7	1	1	0	1	CMR				
8	1	1	1	0	ENS				
9	1	1	1	1	ALR				



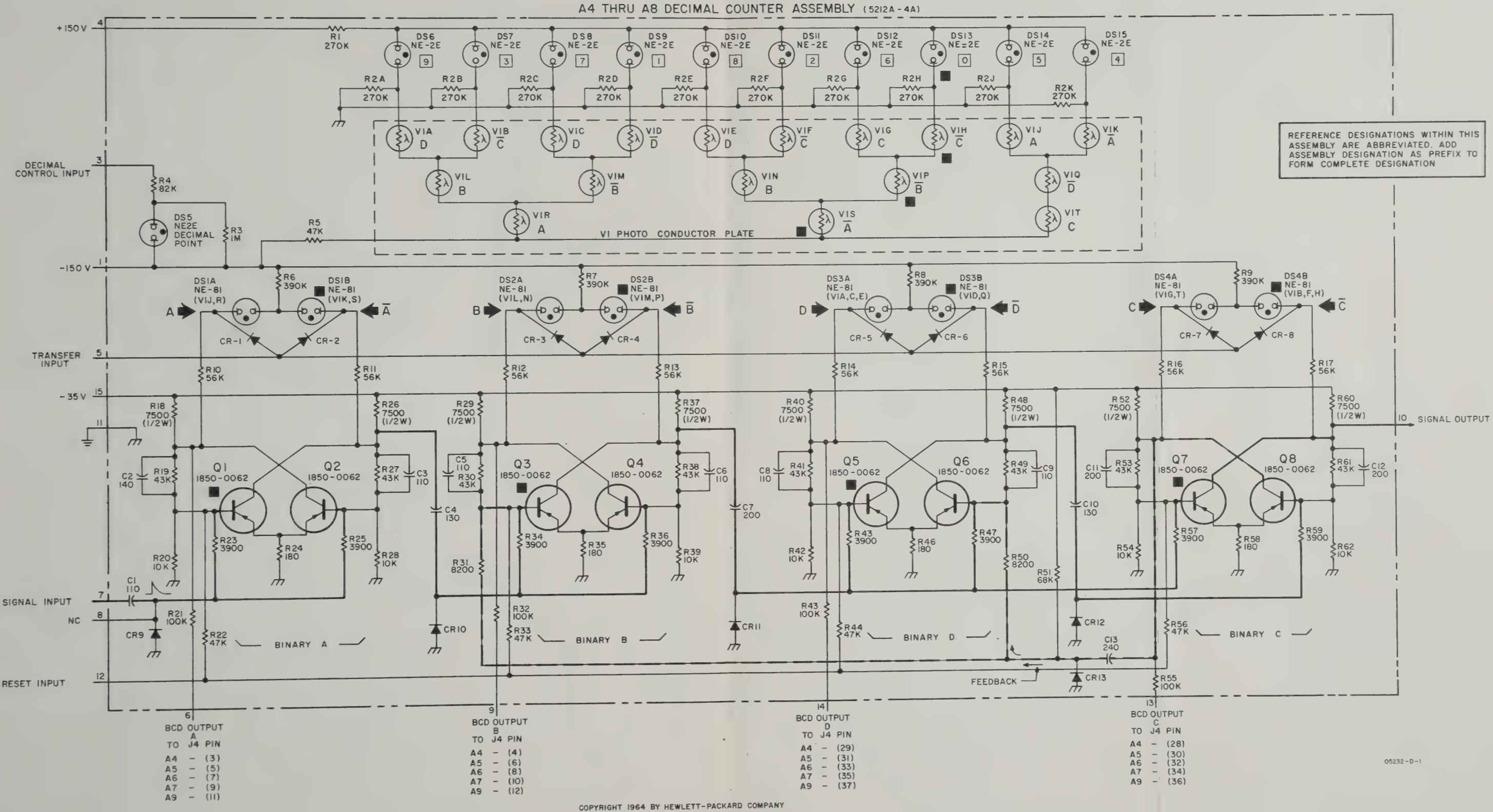
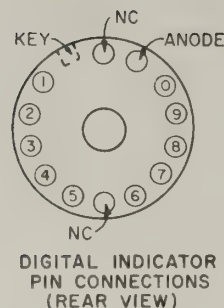


Figure 5-12. Decimal Counter Assemblies A4-A8 (5212A)

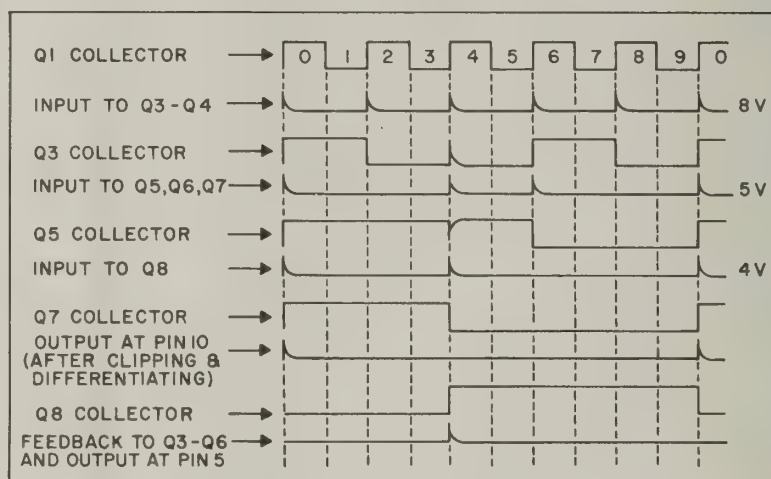
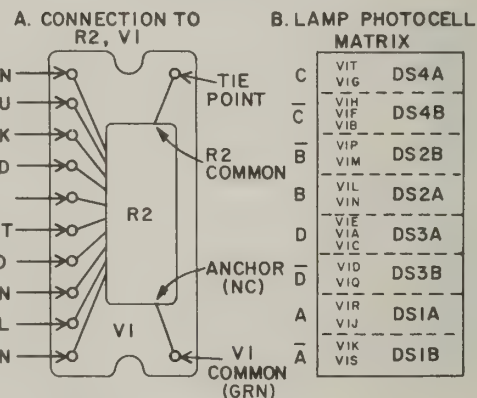
NOTES

1. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS
2. REFERENCE DESIGNATIONS IN PARENTHESES INDICATE LIGHT
DESTINATION FOR DSI-DS4; LIGHT SOURCE IS NOTED
NEAR EACH VI SECTION
3. FILLED SQUARE (■) INDICATES
CONDUCTING ELEMENT FOR
DECIMAL "0" (BCD "0000")
FOR DSI-DS4, SECTION A LIGHTS
ON "1", SECTION B LIGHTS ON "0"



WAVEFORMS

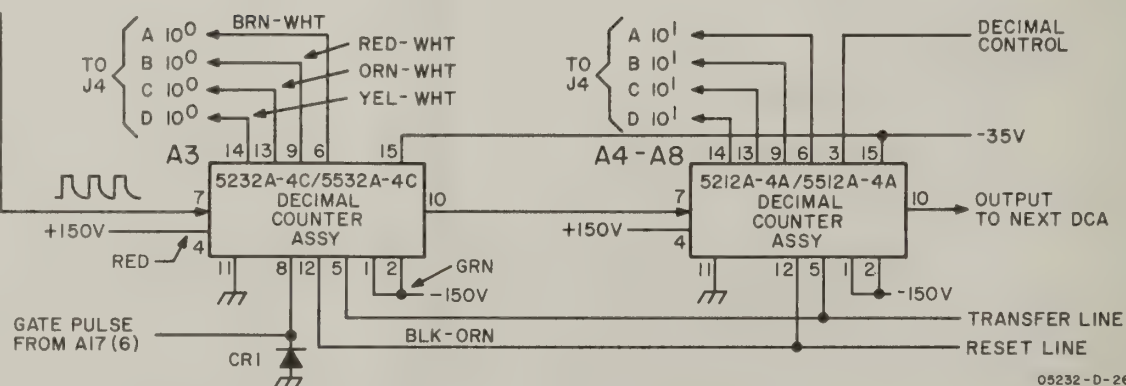
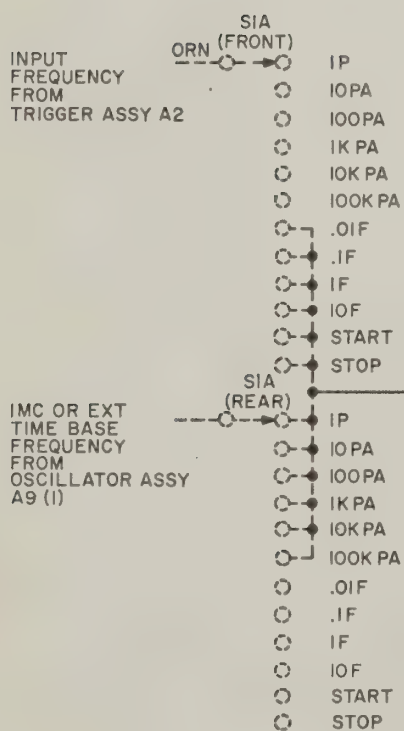
DIGIT	4 LINE CODE (0 = -, 1 = +)				RELEVANT STAGES	BINARY			
	D	C	B	A		D	C	B	A
0	0	0	0	0	HPS	■	■	■	■
1	0	0	0	1	DMR	■	■	■	■
2	0	0	1	0	FNS	■	■	■	■
3	0	0	1	1	BLR	■	■	■	■
4	0	1	1	0	KQT	■	■	■	■
5	0	1	1	1	JQT	■	■	■	■
6	1	1	0	0	GPS	■	■	■	■
7	1	1	0	1	CMR	■	■	■	■
8	1	1	1	0	ENS	■	■	■	■
9	1	1	1	1	ALR	■	■	■	■

PHYSICAL LAYOUT
(PLATE 040-3)

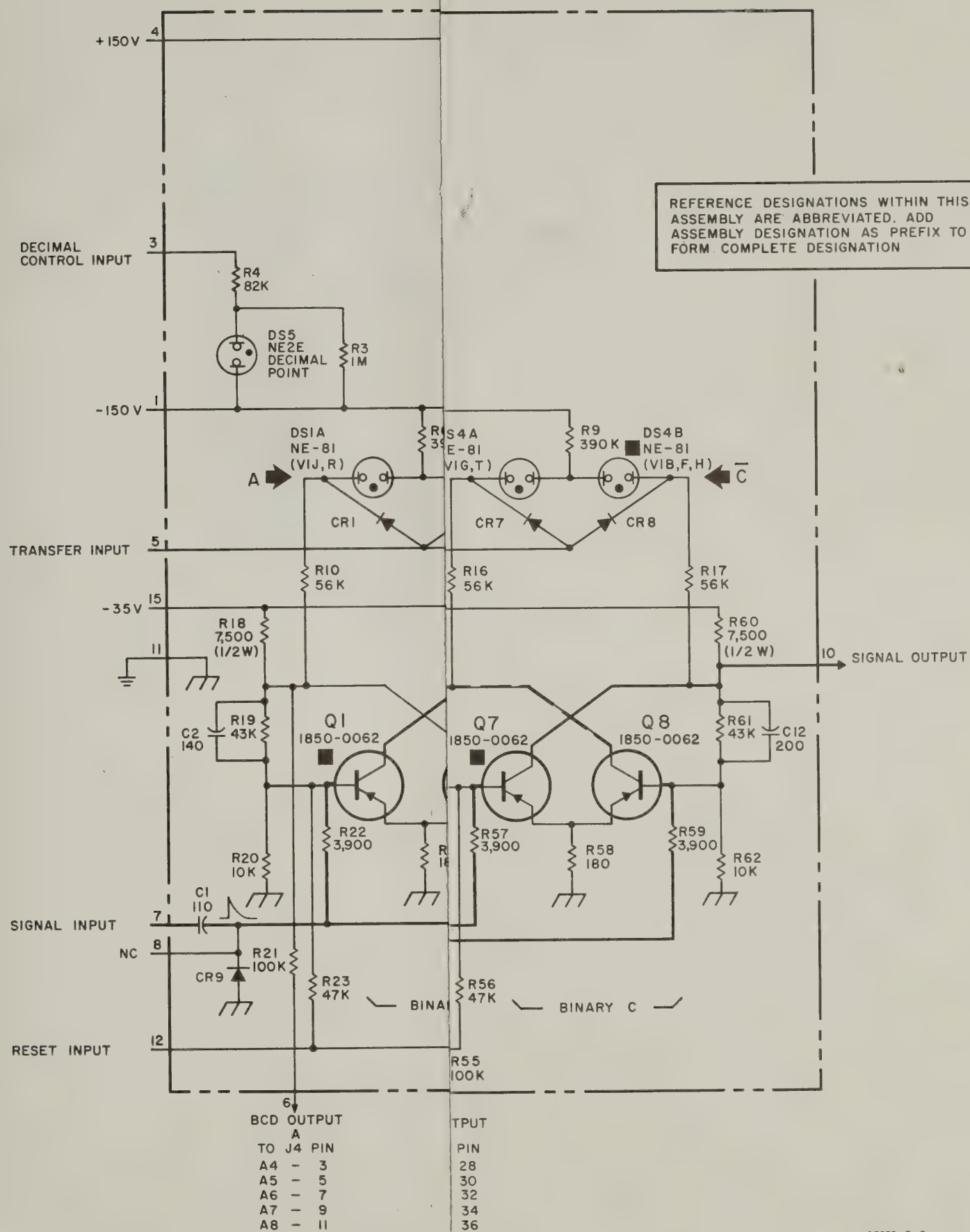
REFERENCE DESIGNATIONS

CI - 13
CRI - 13
DSI - 6
Q1 - 8
R1 - 62
VI

OMITTED: R5



05232-D-26



05232-D-2

Figure 5-14. Decimal Counter Assemblies A4-A8 (5512A)

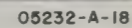
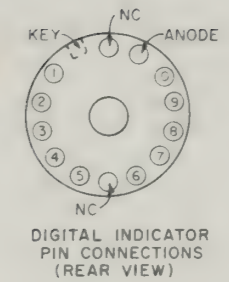
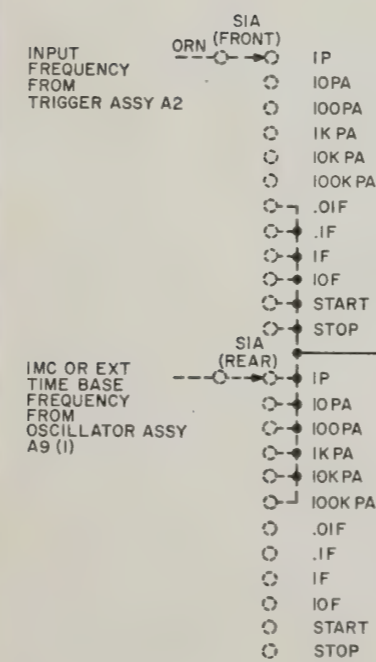
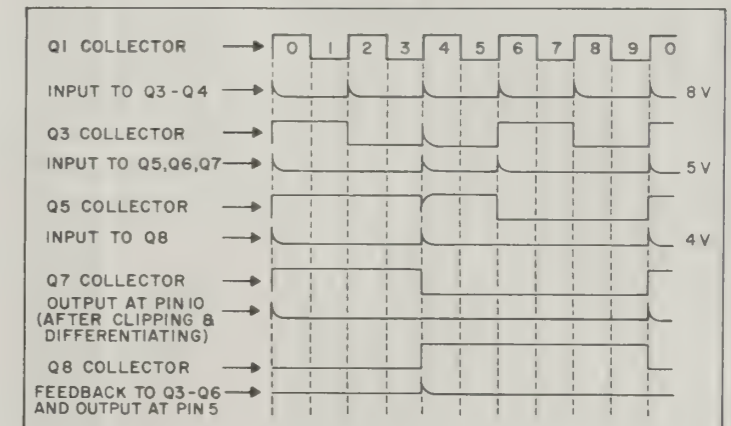


Figure 5-13. Component Location A4-A8

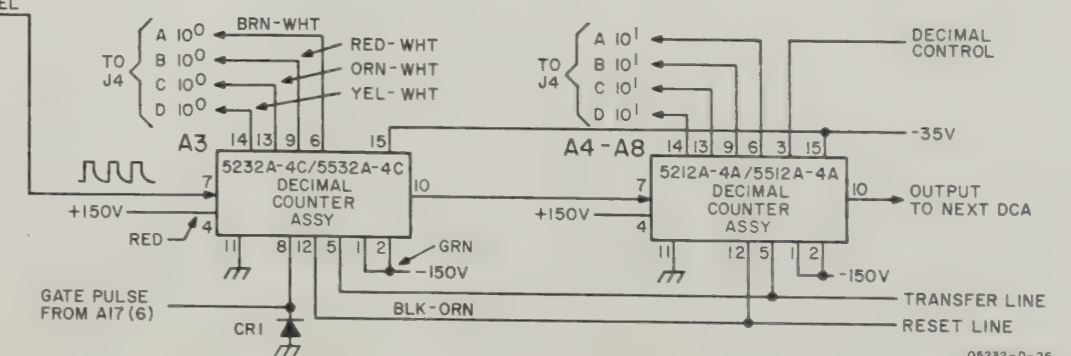
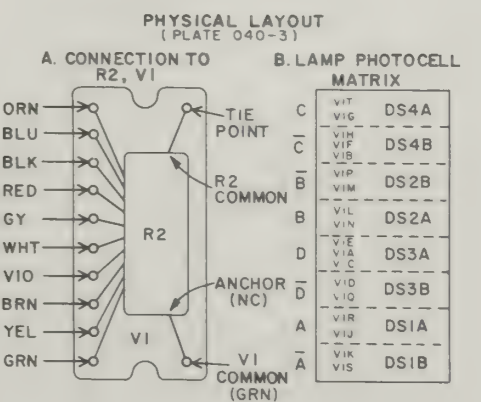
1. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS
2. REFERENCE DESIGNATIONS IN PARENTHESES INDICATE LIGHT
DESTINATION FOR DSI-DS4; LIGHT SOURCE IS NOTED
NEAR EACH VI SECTION
3. FILLED SQUARE (■) INDICATES
CONDUCTING ELEMENT FOR
DECIMAL "0" (BCD "0000")
FOR DSI-DS4, SECTION A LIGHTS
ON "1", SECTION B LIGHTS ON "0"



DIGIT	4 LINE CODE (0 = -, 1 = +)				RELEVANT STAGES				
					VI	BINARY			
	D	C	B	A			D	C	B
0	0	0	0	0	HPS				
1	0	0	0	1	DMR				
2	0	0	1	0	FNS				
3	0	0	1	1	BLR				
4	0	1	1	0	QQT				
5	0	1	1	1	JQT				
6	1	1	0	0	GPS				
7	1	1	0	1	CMR				
8	1	1	1	0	ENS				
9	1	1	1	1	ALR				



CI - 13
CRI - 13
DSI - 6
QI - 8
RI - 62
VI



05232-D-26

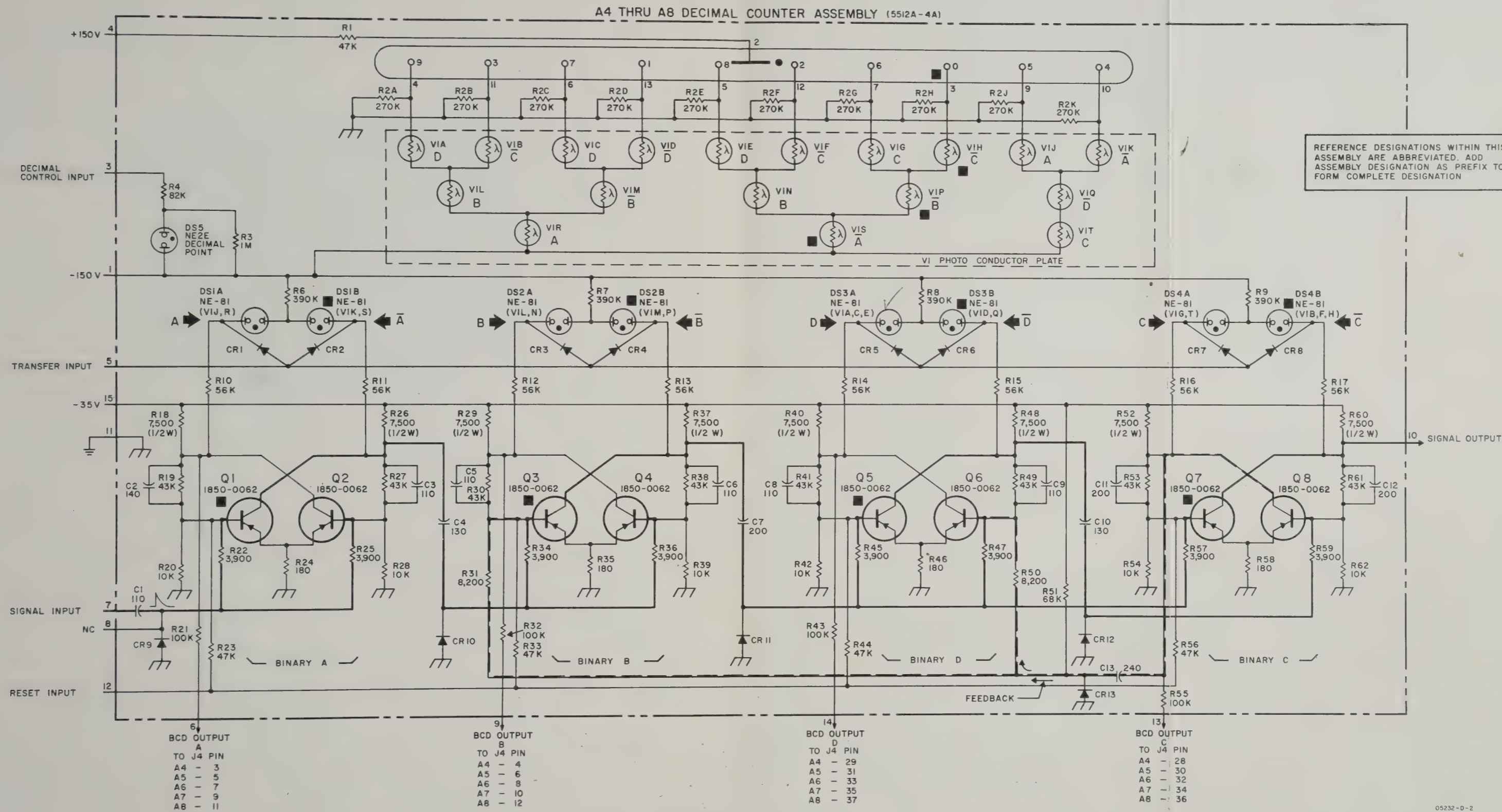


Figure 5-14. Decimal Counter Assemblies A4-A8 (5512A)

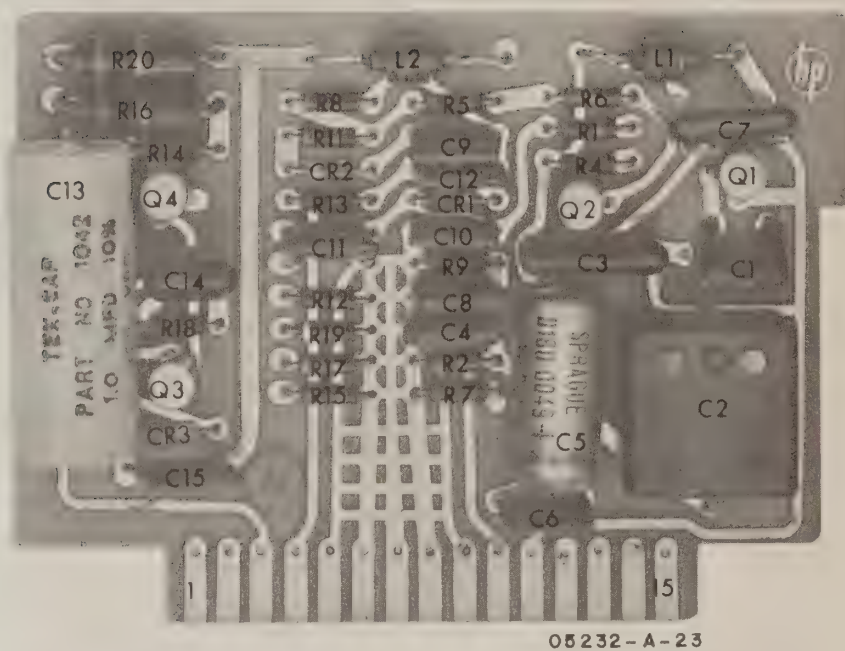
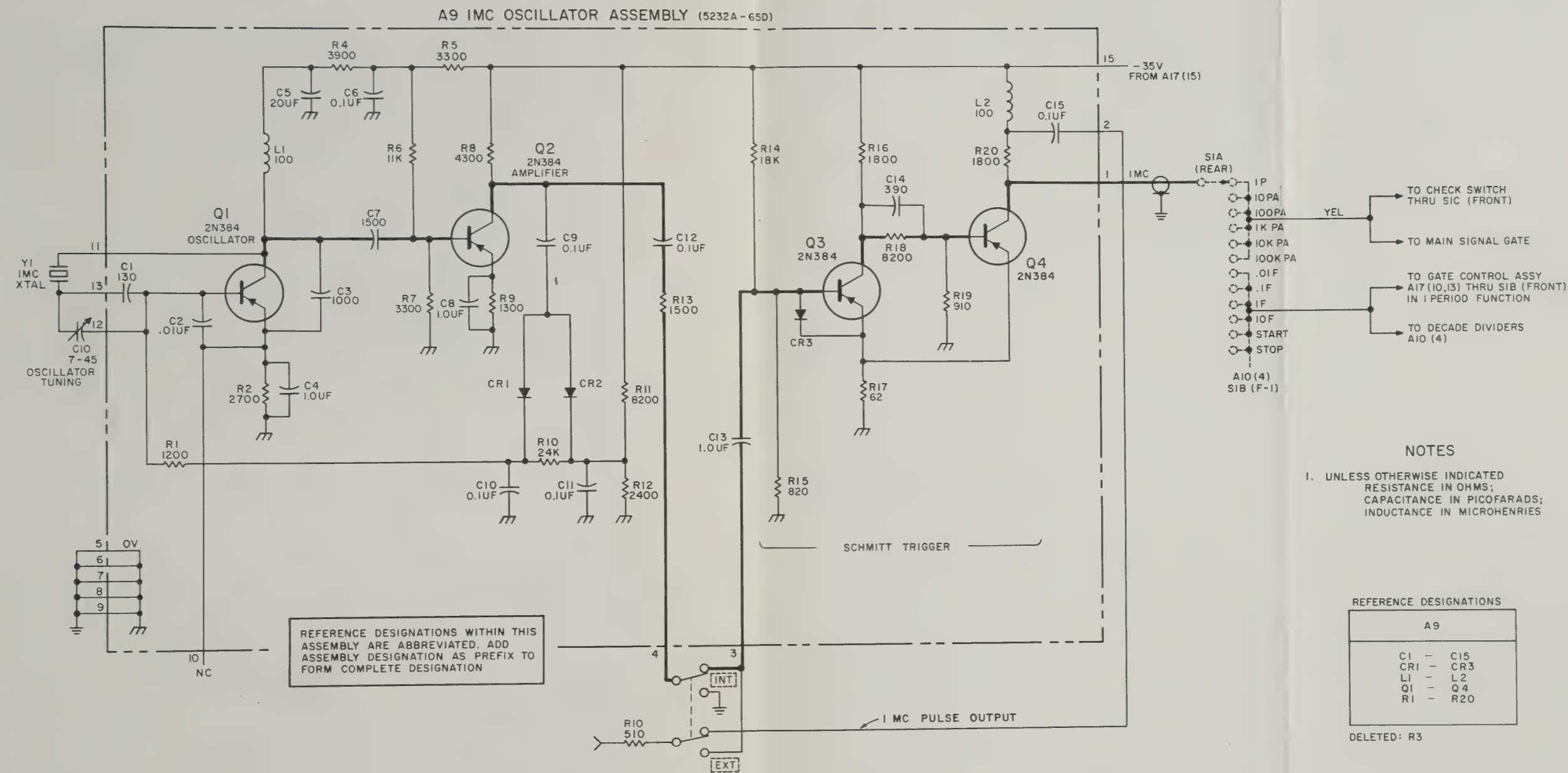


Figure 5-15. Component Location A9



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05232-D-8

Figure 5-16. Oscillator Assembly A9

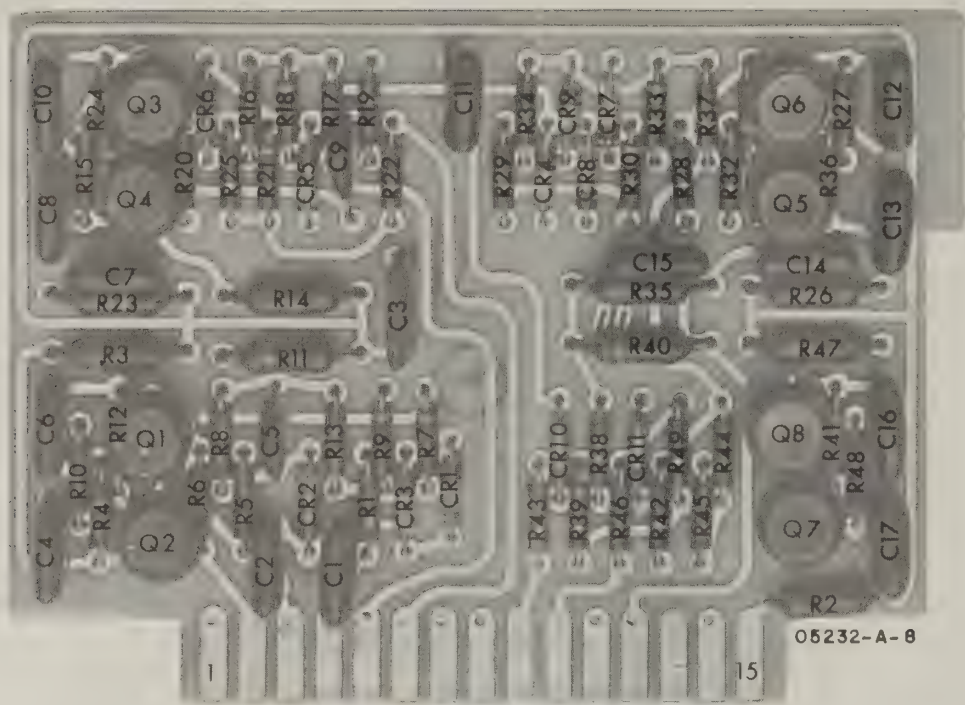
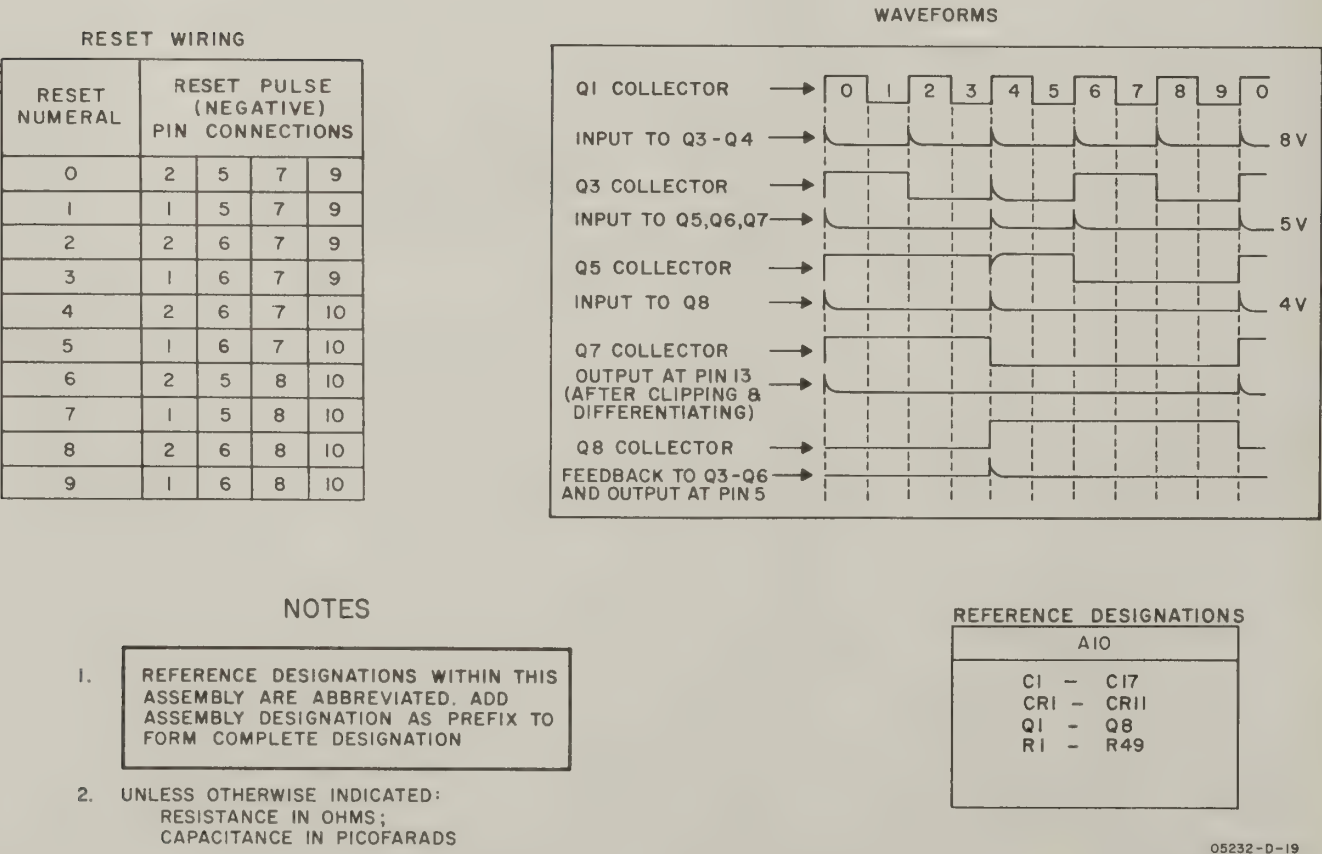


Figure 5-17. Component Location A10



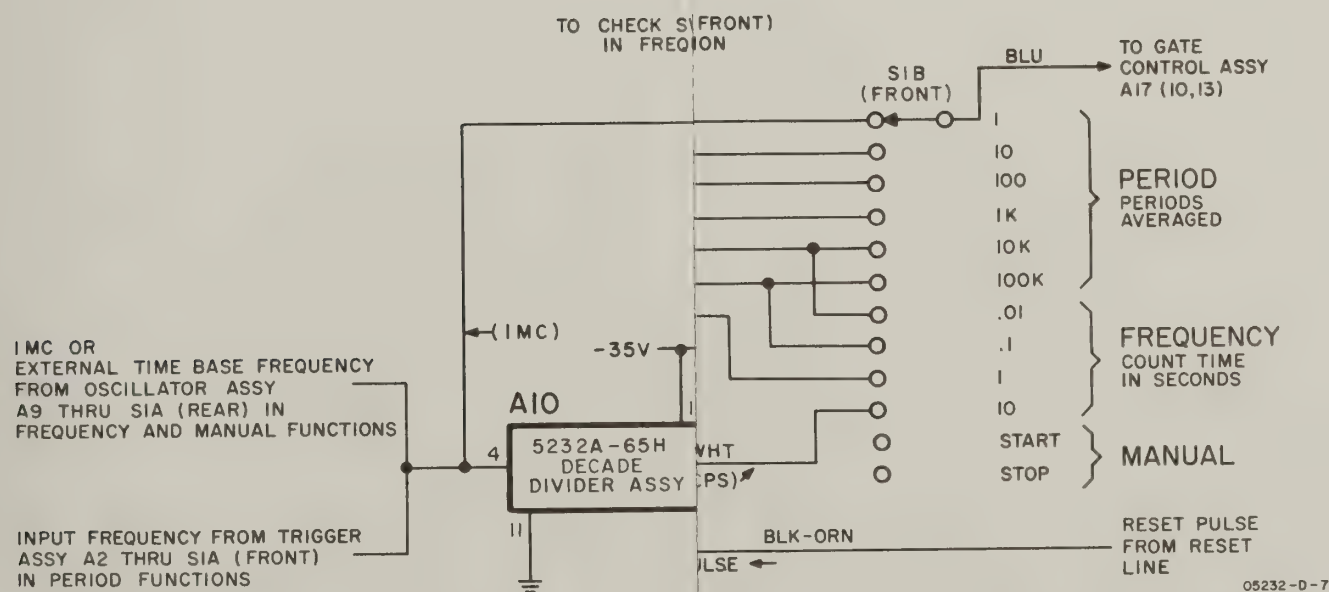
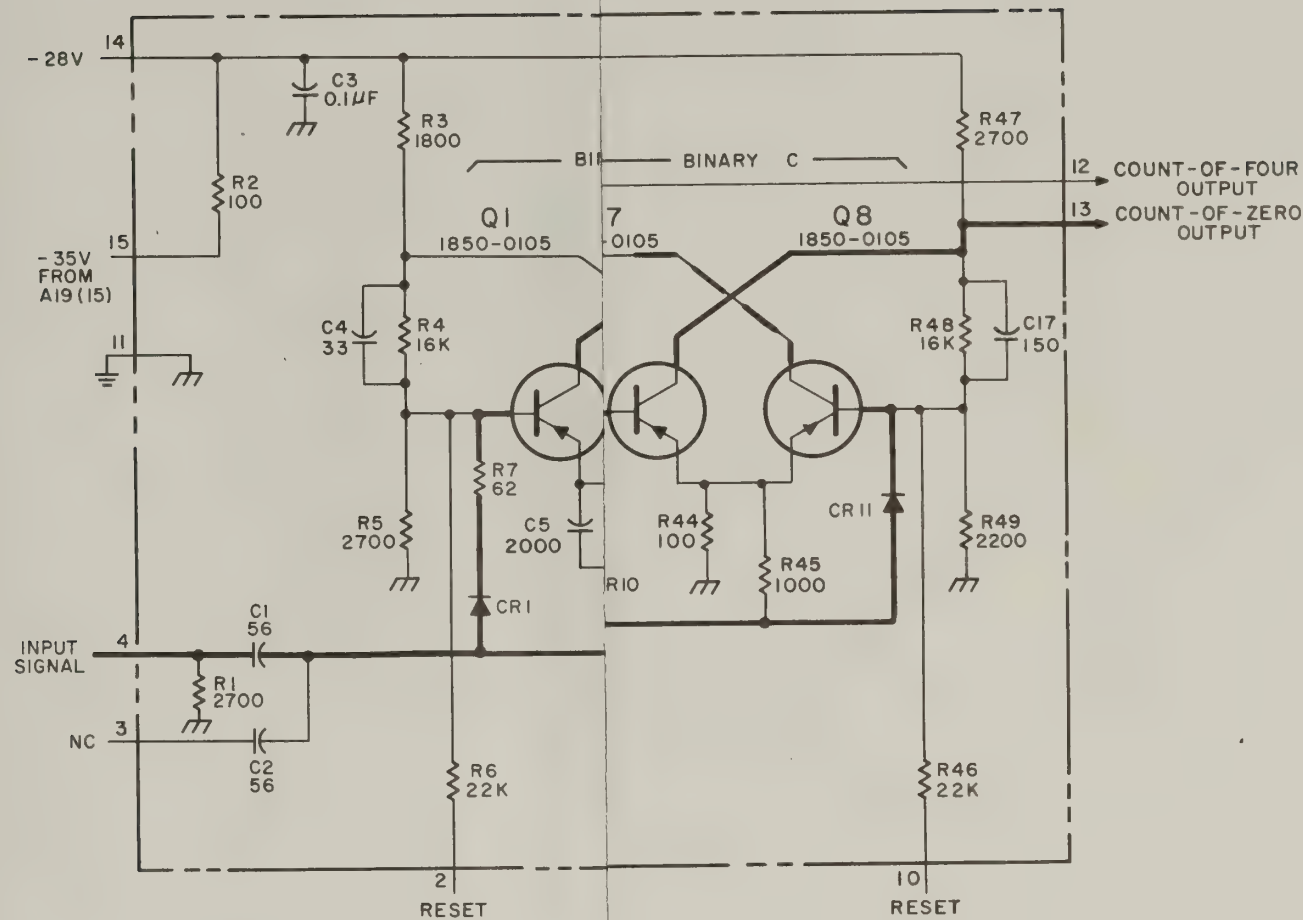


Figure 5-18. Decade Divider Assembly A10

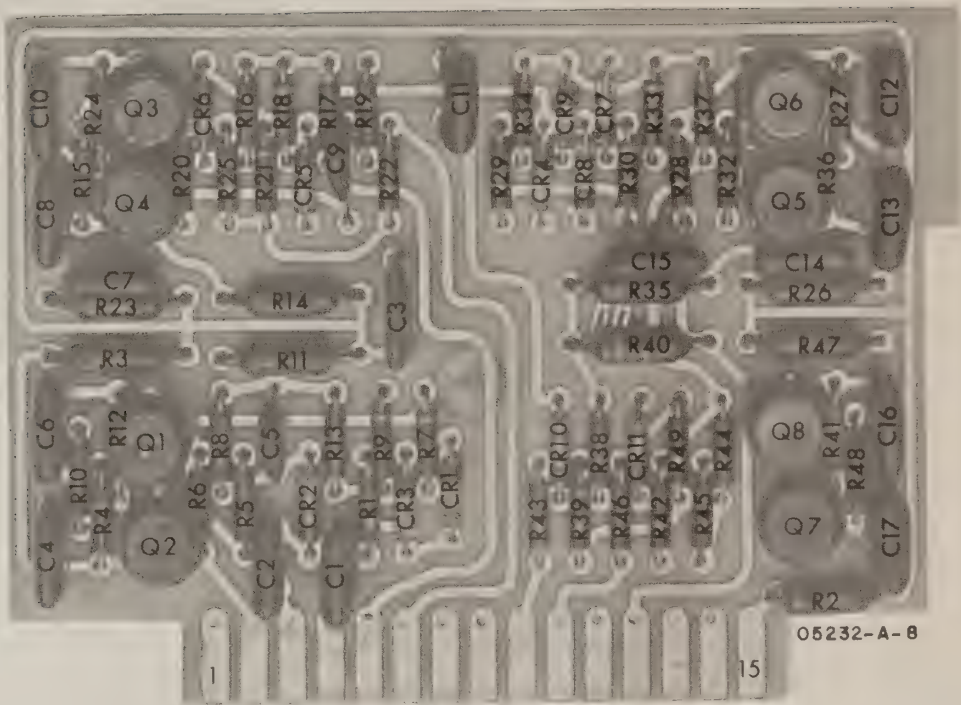
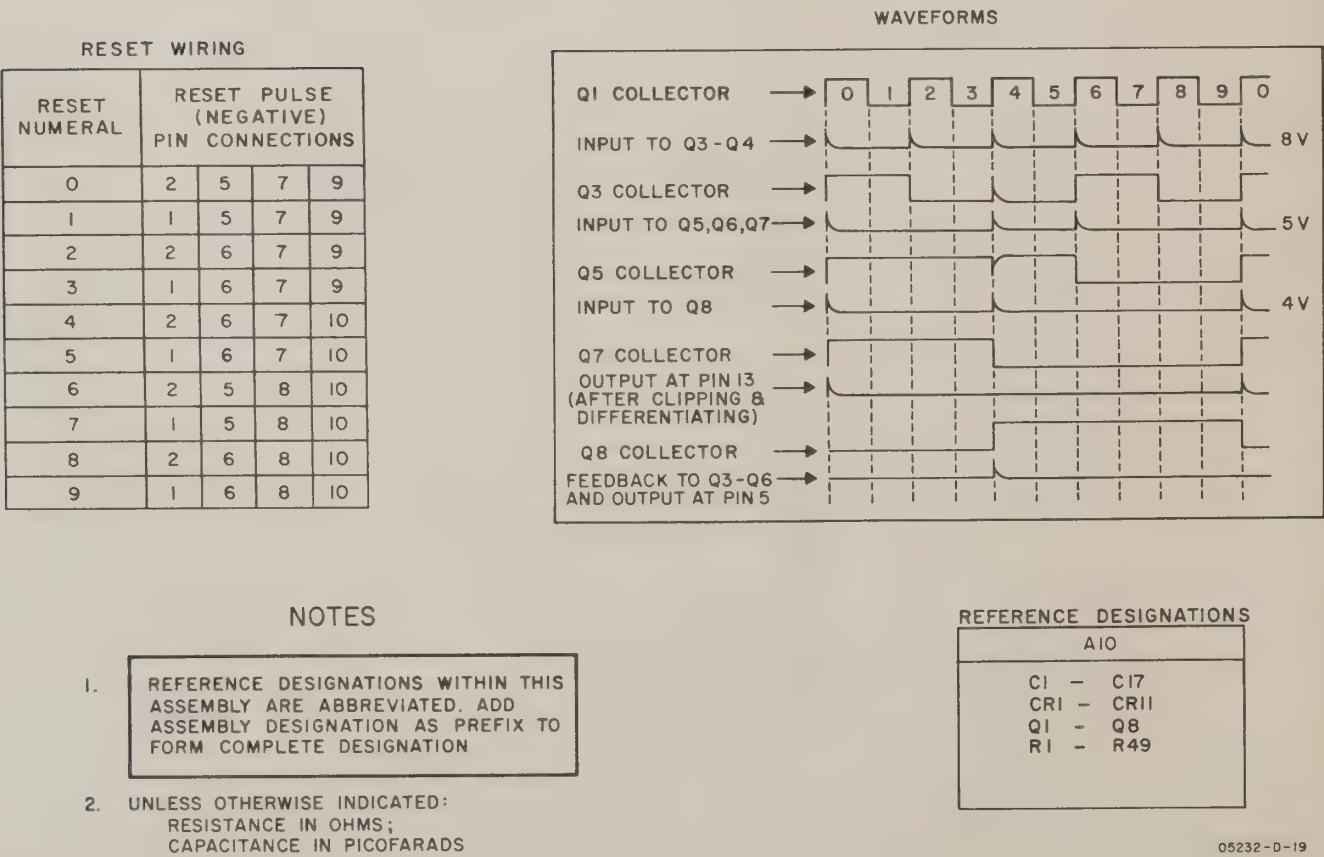


Figure 5-17. Component Location A10



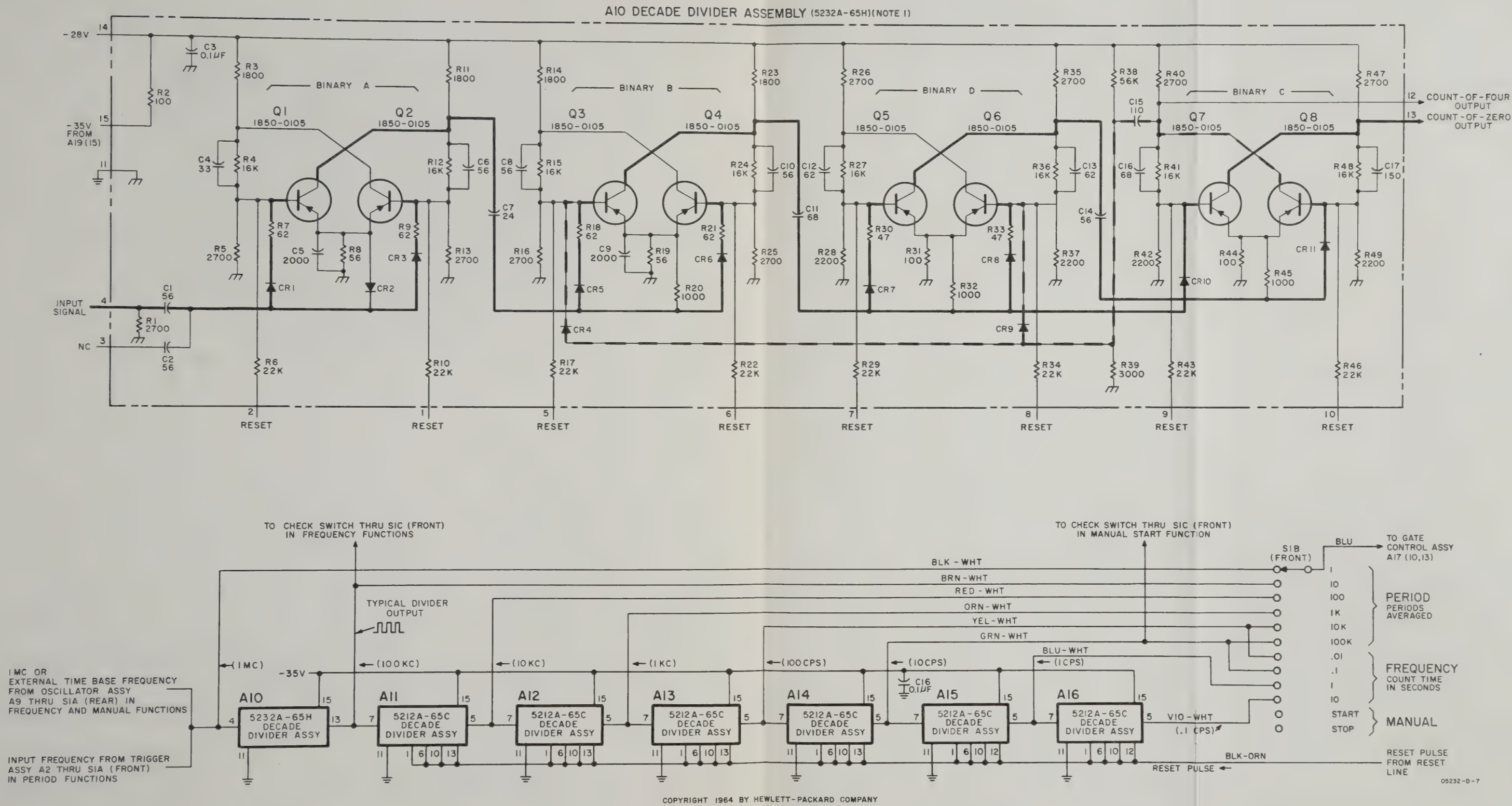


Figure 5-18. Decade Divider Assembly A10

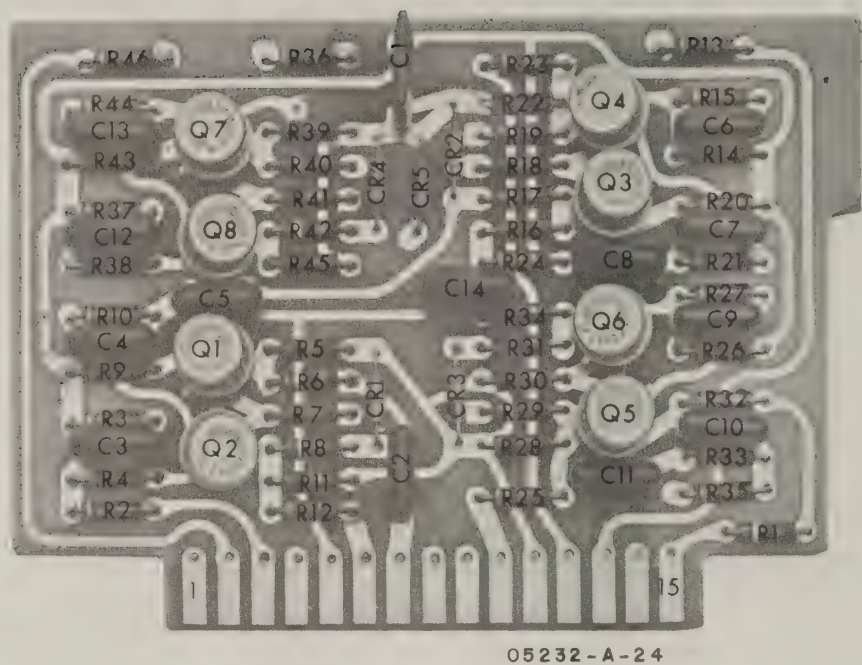
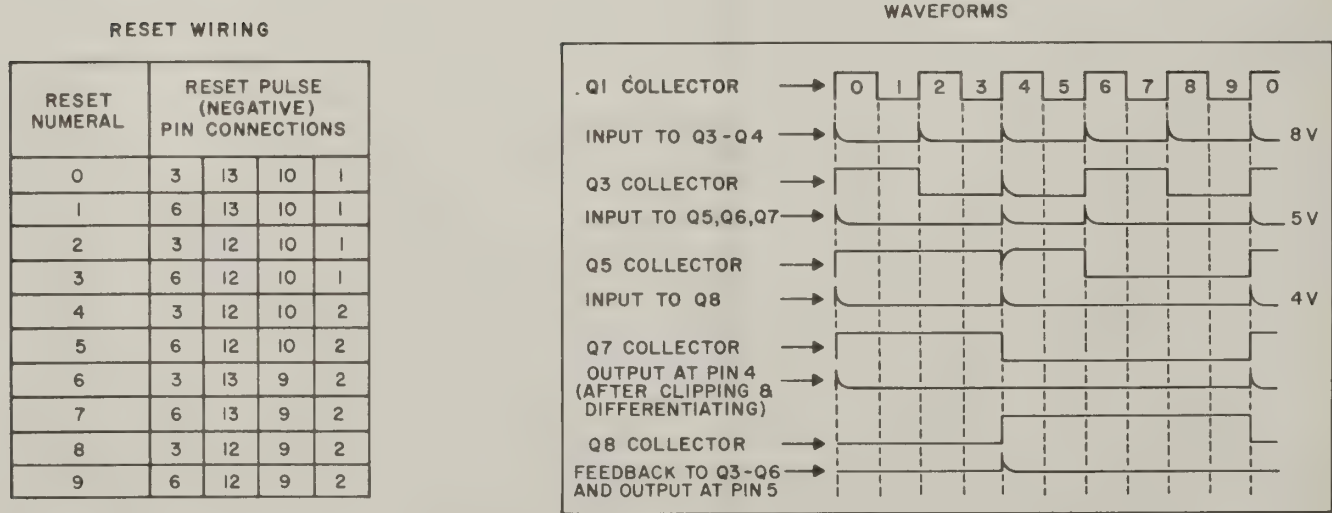


Figure 5-19. Component Location A11-A16



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS

REFERENCE DESIGNATIONS
A11-A16
C1-14
CR1-5
Q1-8
R1-46

05232-D-20

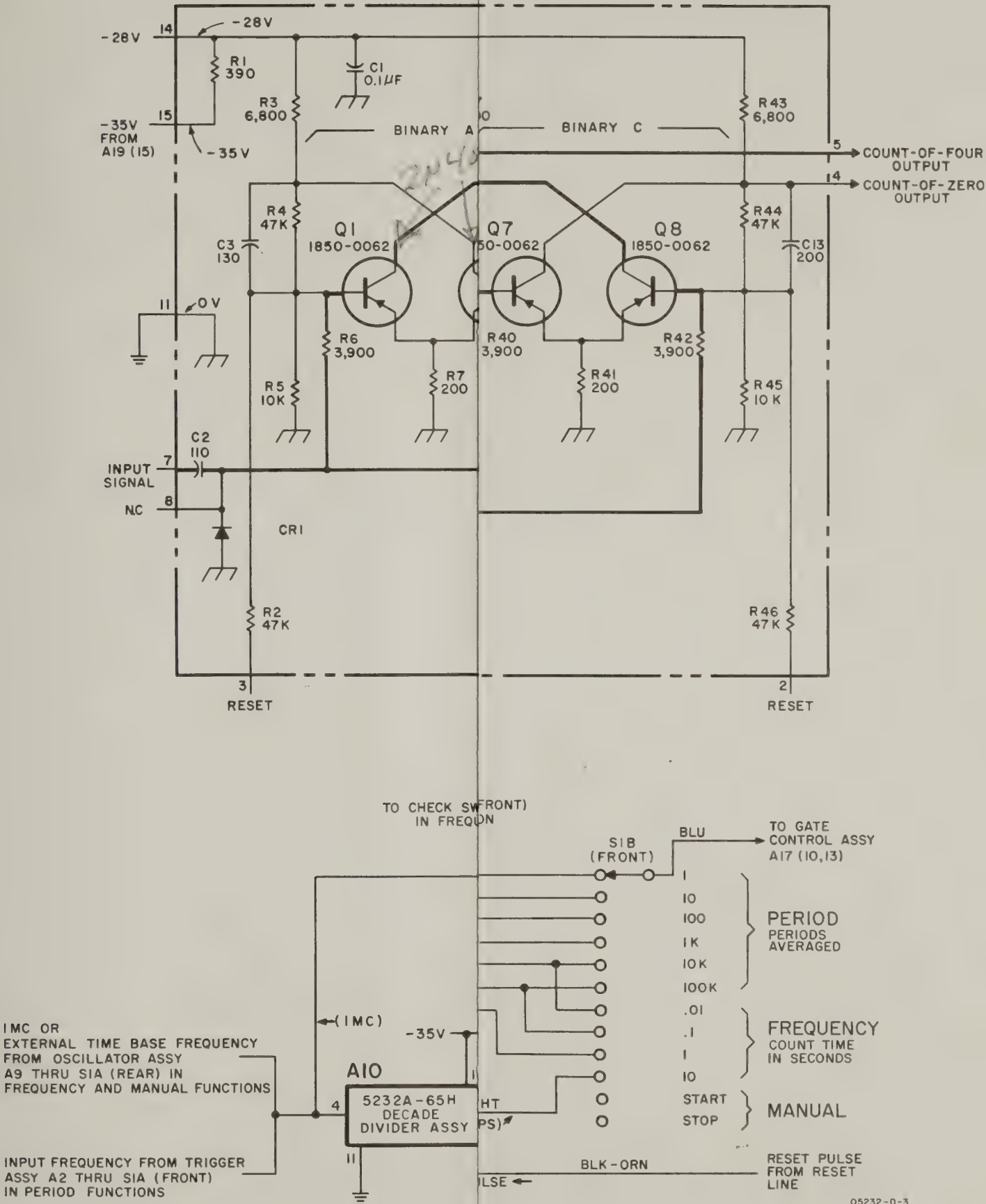


Figure 5-20. Decade Divider Assemblies A11-A16

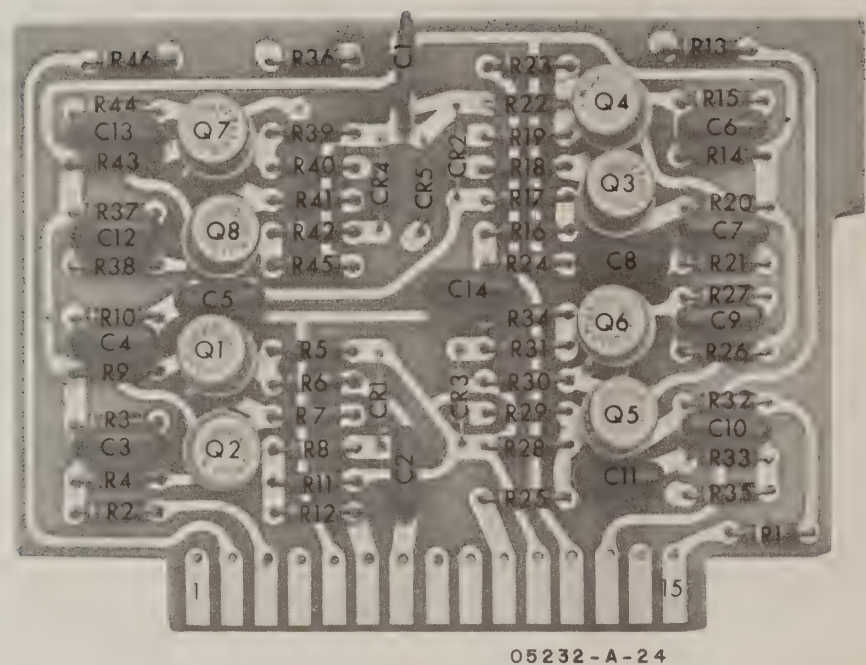
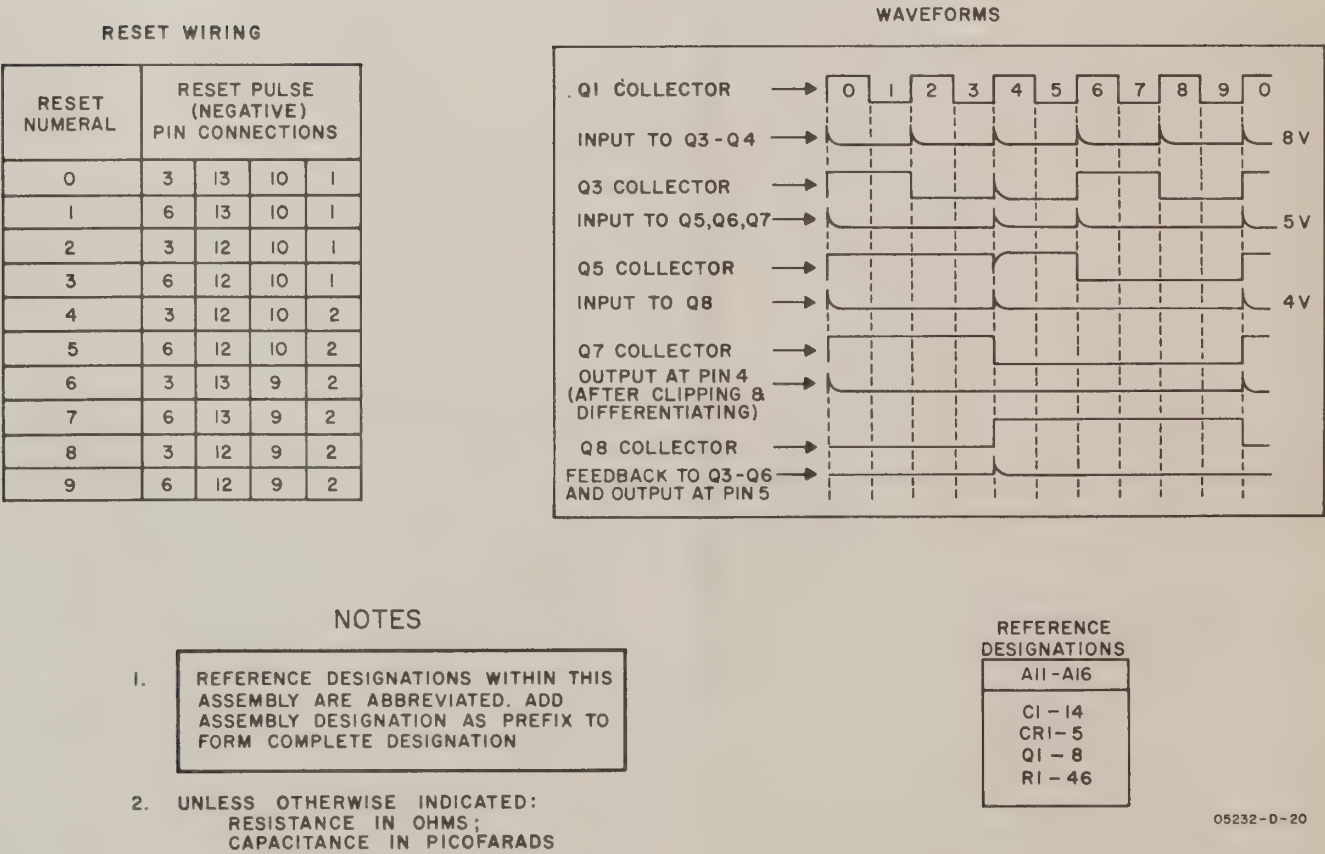


Figure 5-19. Component Location A11-A16



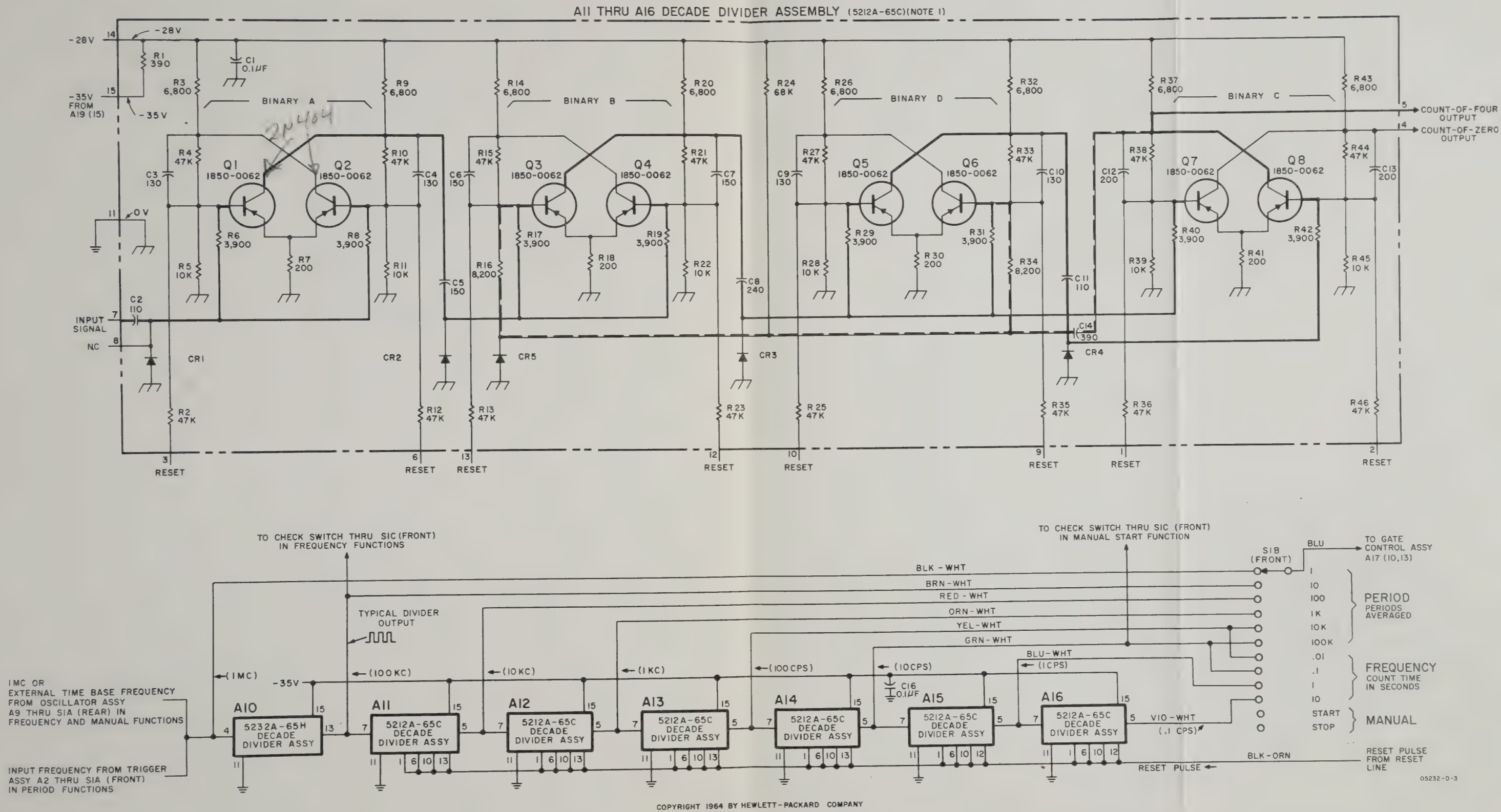
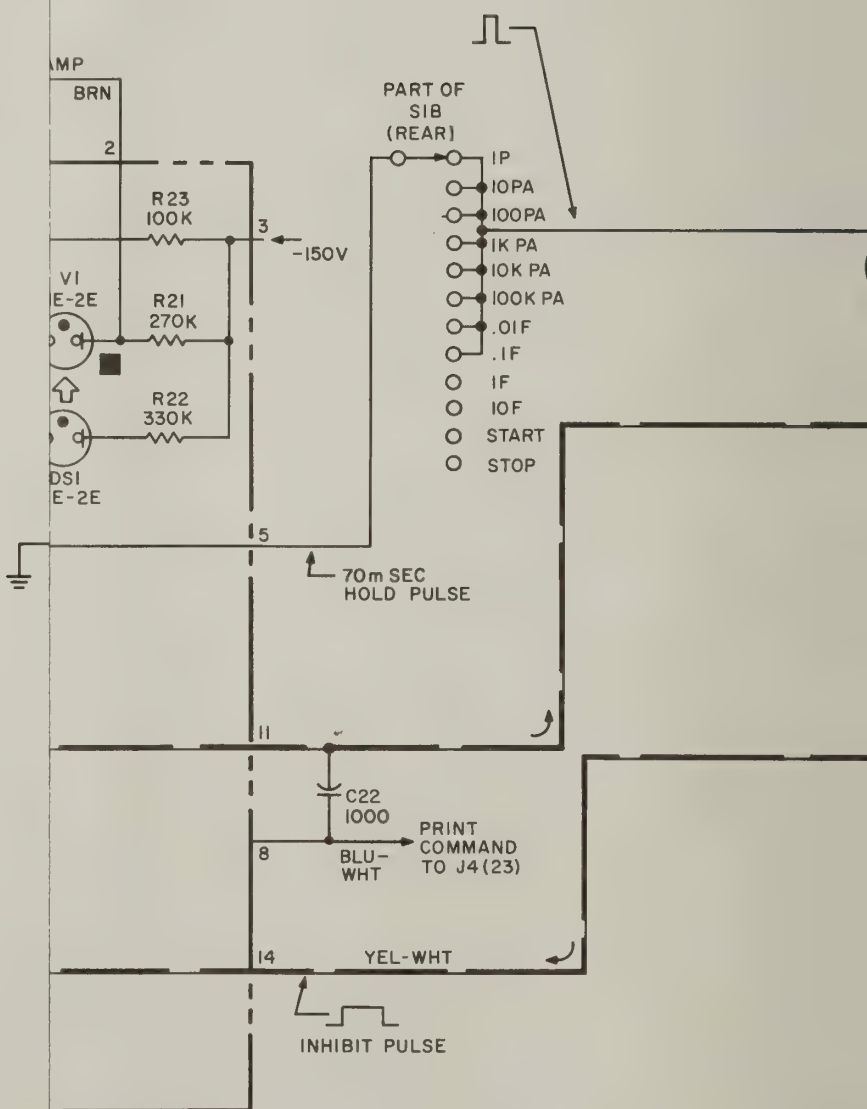
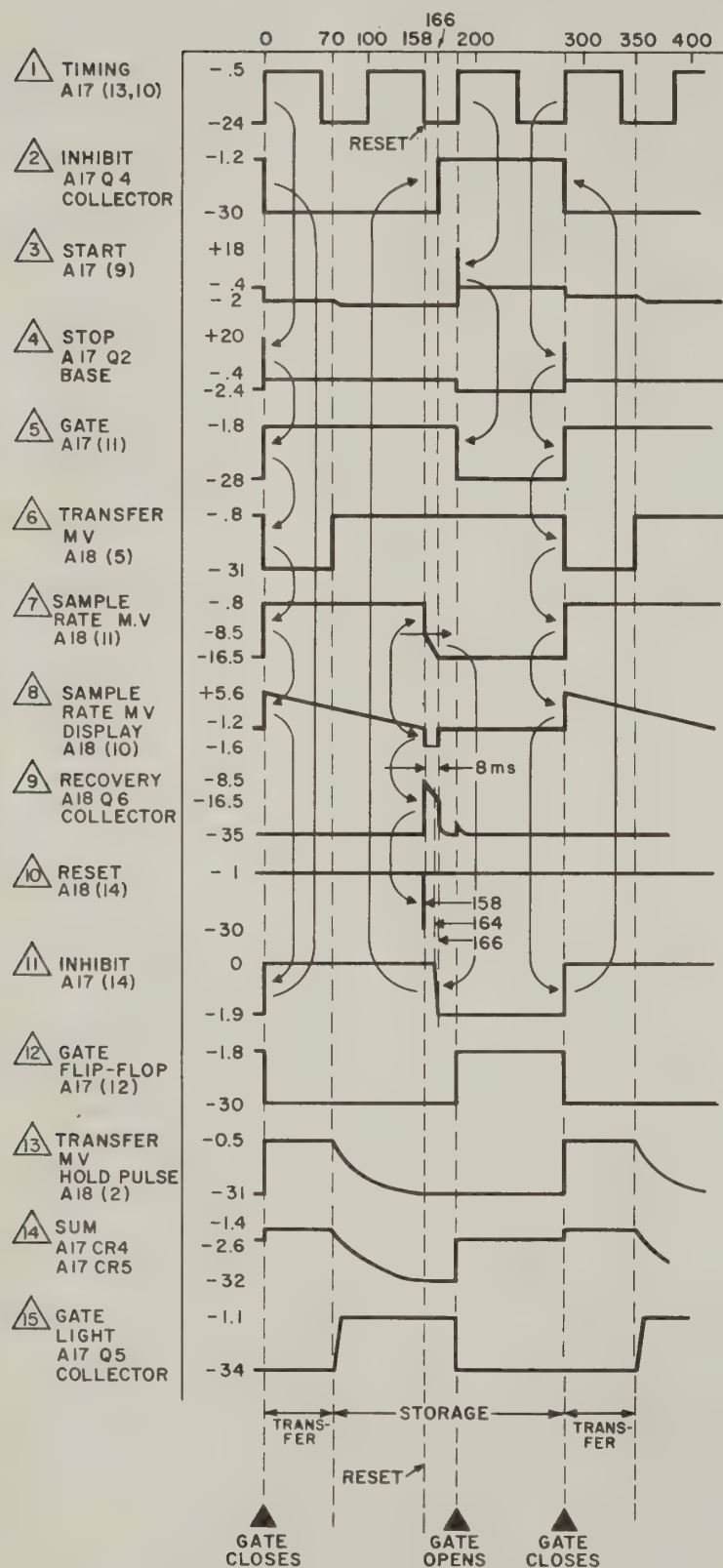


Figure 5-20. Decade Divider Assemblies A11-A16

WAVEFORM CHART

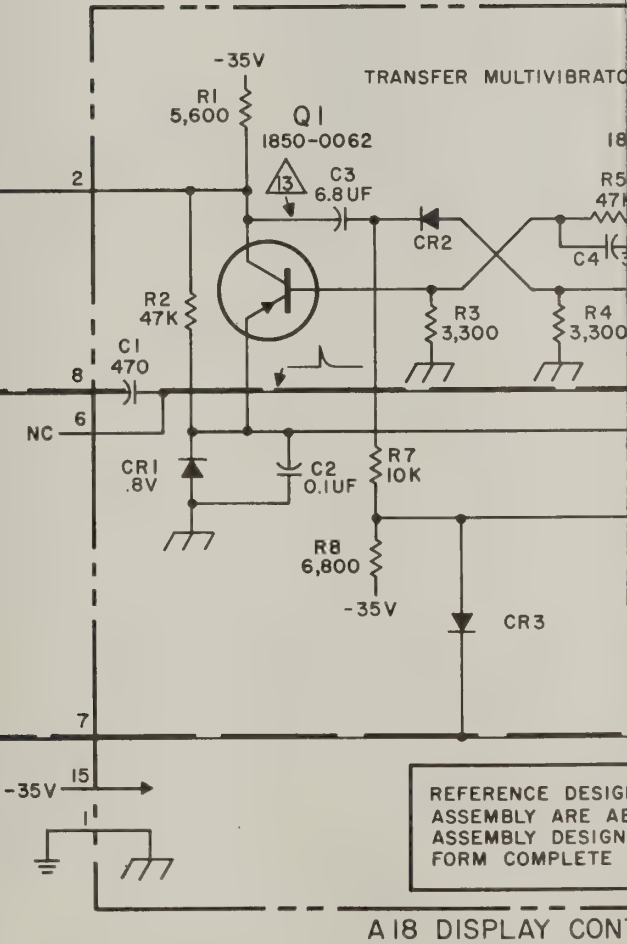
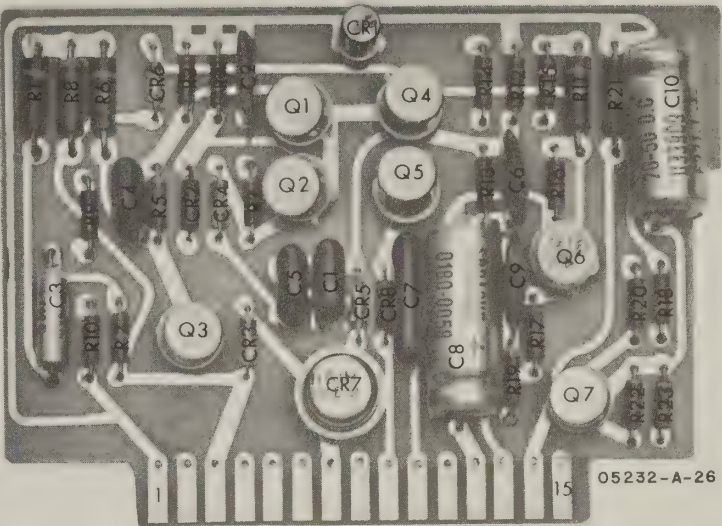
FUNCTION SWITCH: 0.1 SEC GATE.
INPUT SWITCH: CHECK.
DISPLAY CONTROL: MINIMUM (CCW).
OSCILLOSCOPE SYNC: FROM A17 (12).
OSCILLOSCOPE TRIGGERING: NEG SLOPE,
NEG LEVEL.
VERTICAL ARROWS INDICATE SIGNAL FLOW.



05232-D-17

Figure 5-21. Gate Control Assembly A17

- NO
- 1. SIC(REAR) AND SID(R
 - CONTACTS; NO-DETE
 - 2. UNLESS OTHERWISE
 - RESISTANCE IN OH
 - 3. FILLED SQUARE (■)
 - FOLLOWING RETURN



REFERENCE DESIGNATIONS

A17	A18	NO PREFIX
C1 - 6	C1 - 10	C 20,22
CR1 - 7	CR1 - 8	DS1
DS1		
Q1 - 5	Q1 - 7	R18-20
R1 - 23	R1 - 23	SI, 4-6
VI		

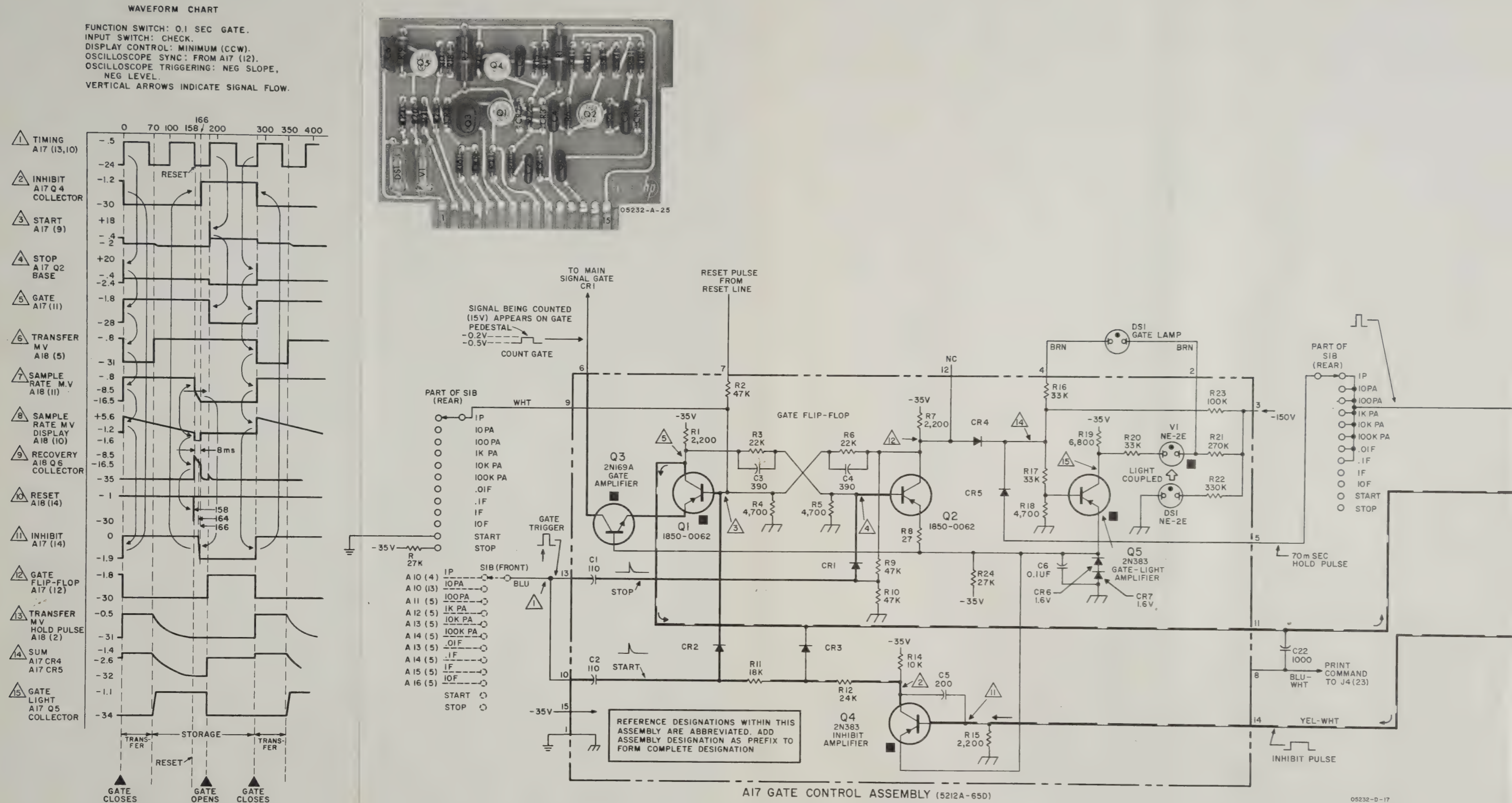
OMITTED: A17R13

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05232-D-18

Figure 5-22. Display Control Assembly A18

02017-1



- NOTES
- 1. SIC(REAR) AND SID(REAR) PROVIDE NORMALLY OPEN CONTACTS; NO-DETENT CONTACTS MAKE WHILE SWITCHING.
 - 2. UNLESS OTHERWISE NOTED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS
 - 3. FILLED SQUARE (■) INDICATES CONDUCTING ELEMENT FOLLOWING RETURN TO QUIESCENT STATE AFTER RESET.

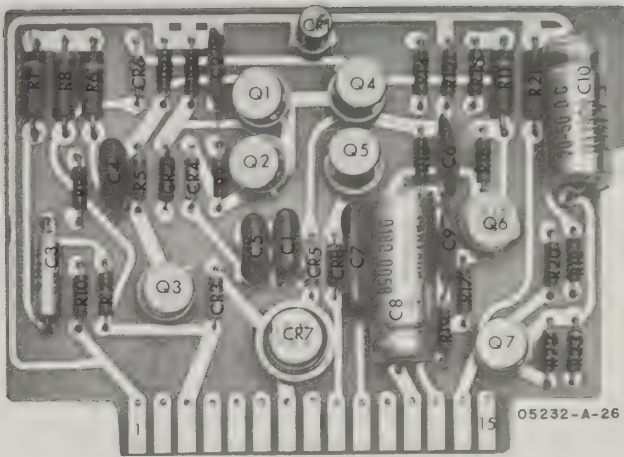
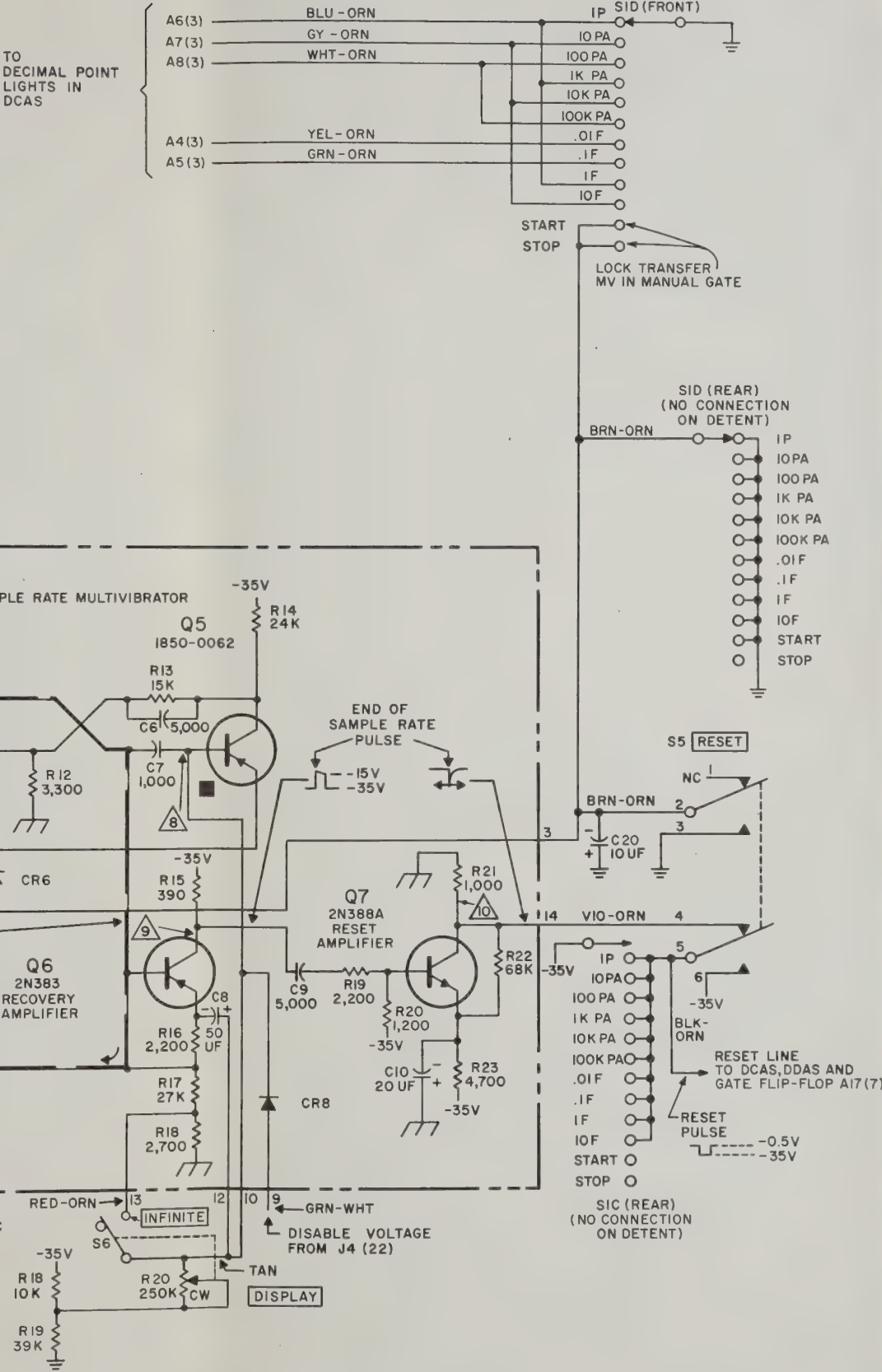


Figure 5-22. Display Control Assembly A18

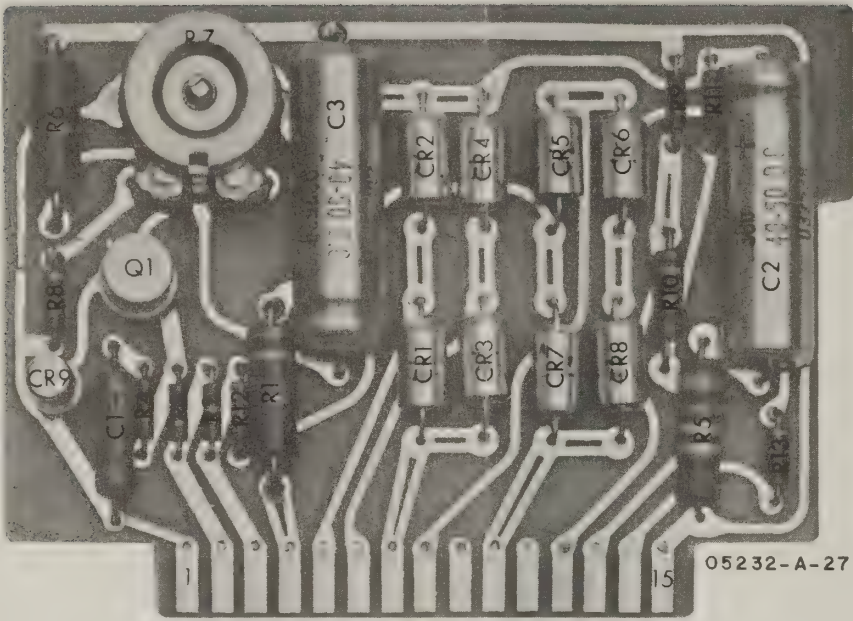
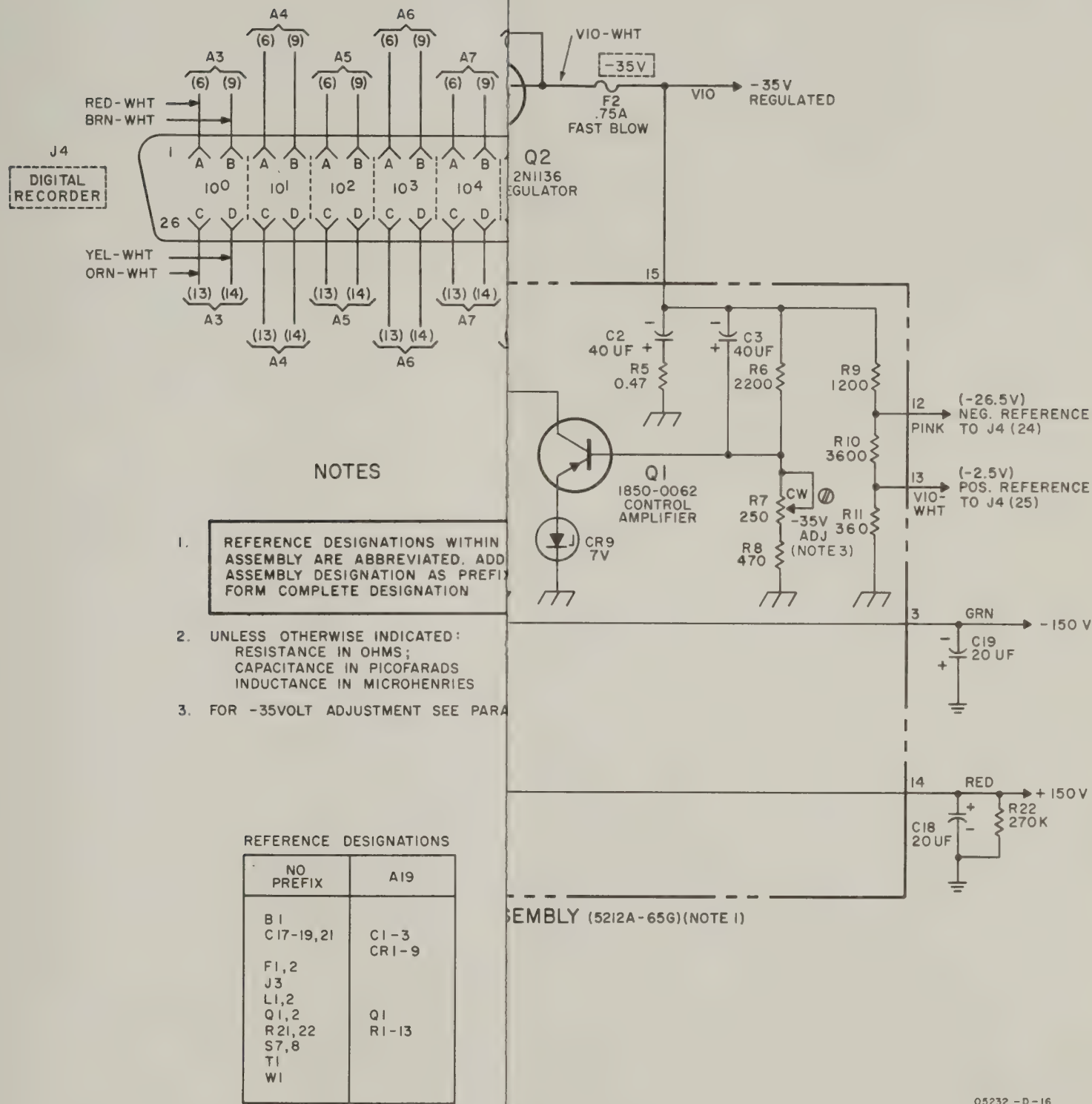


Figure 5-23. Component Location A19



05232 - D - 16

Figure 5-24. Power Supply Assembly A19

5-33/5-34

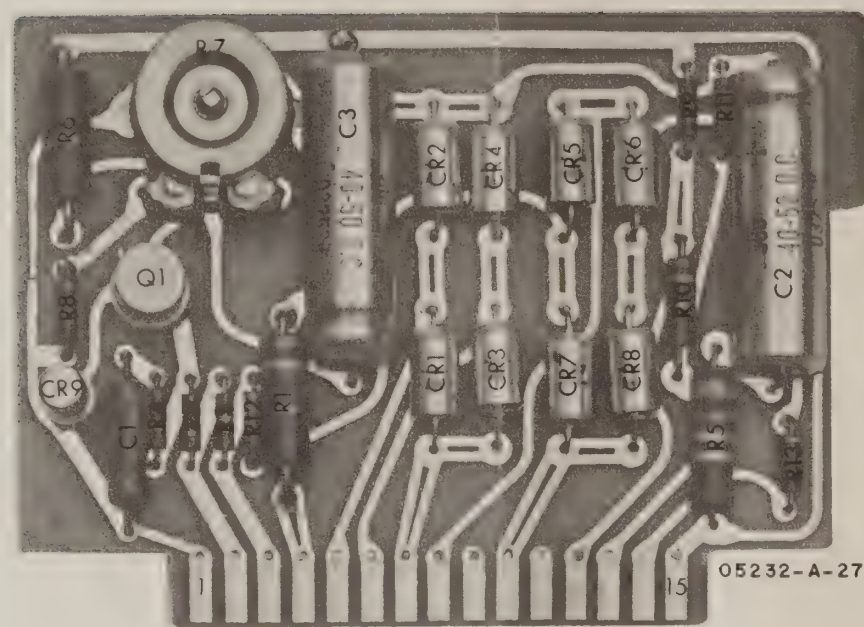
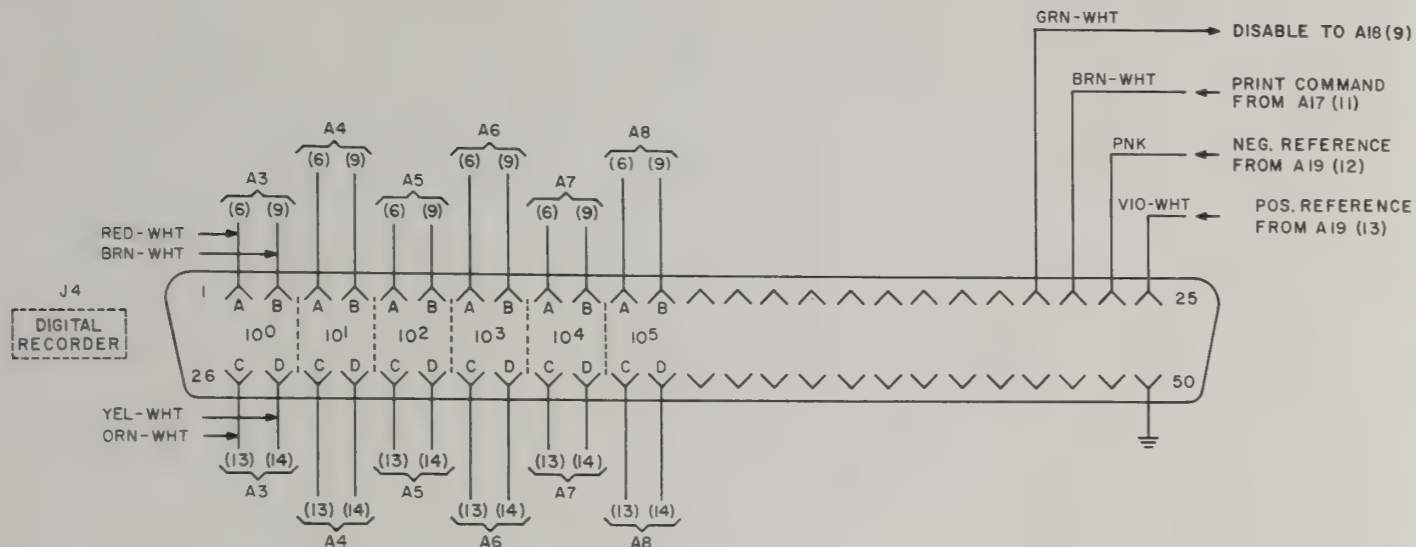


Figure 5-23. Component Location A19



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICO FARADS
INDUCTANCE IN MICROHENRIES
3. FOR -35VOLT ADJUSTMENT SEE PARAGRAPHS

REFERENCE DESIGNATIONS

NO PREFIX	A19
B1	C1-3
C17-19,21	CR1-9
F1,2	
J3	
L1,2	
Q1,2	Q1
R21,22	R1-13
S7,8	
T1	
W1	

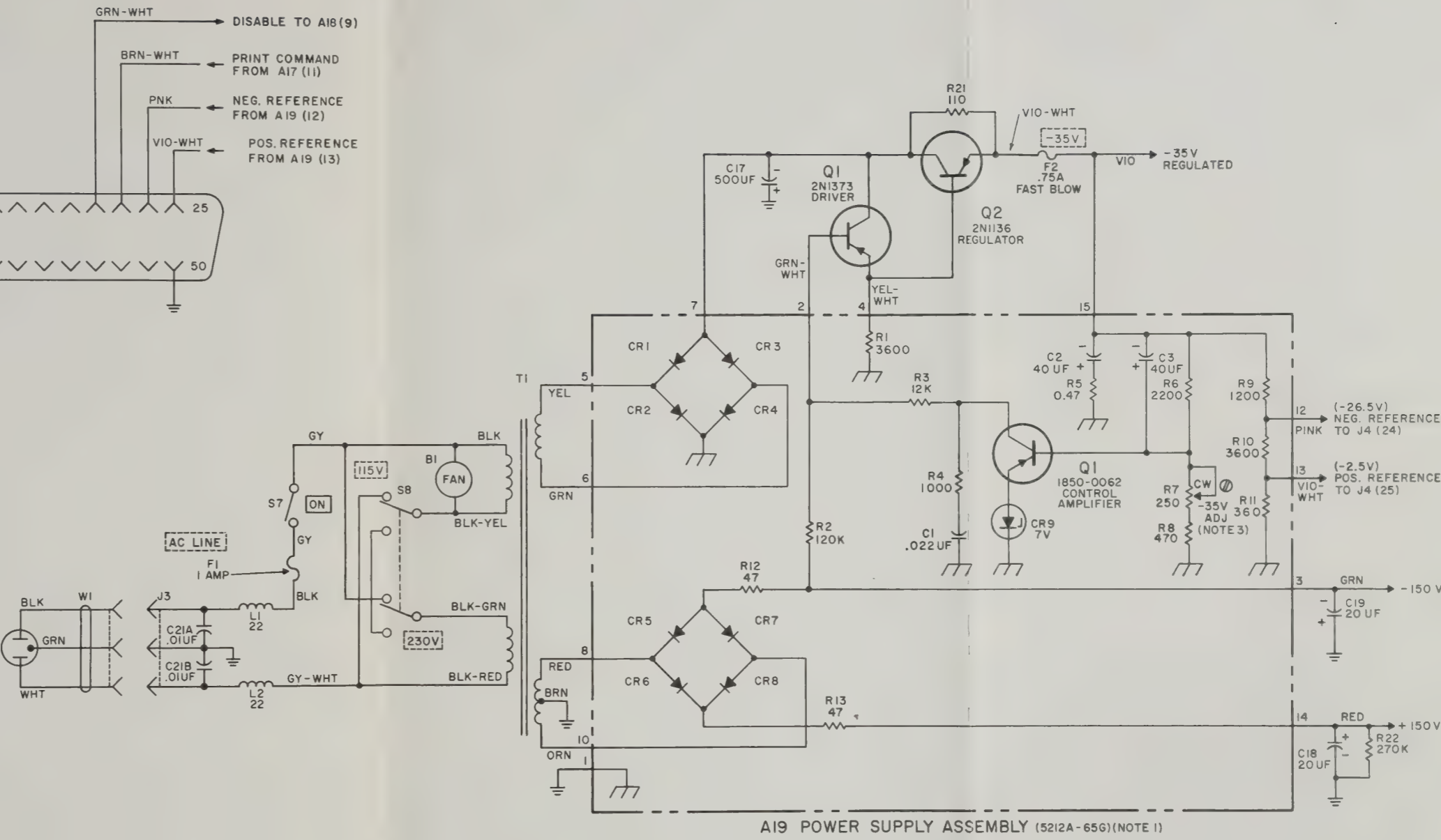


Figure 5-24. Power Supply Assembly A19
5-33/5-34

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and ϕ stock number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their ϕ stock number and provides the following information on each part:

- a. Description of the part (see list of abbreviations below).
- b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-3.
- c. Manufacturer's part number.
- d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office (see maps at rear of this manual for addresses). Identify parts by their Hewlett-Packard stock numbers.

6-6. To obtain a part that is not listed, include:

- a. Instrument model number.
- b. Instrument serial number.
- c. Description of the part.
- d. Function and location of the part.

REFERENCE DESIGNATORS

A = assembly	E = misc electronic part	MP = mechanical part	TB = terminal board
B = motor	F = fuse	P = plug	TP = test point
C = capacitor	FL = filter	Q = transistor	V = vacuum tube, neon bulb, photocell, etc.
CP = coupling	J = jack	R = resistor	W = cable
CR = diode	K = relay	RT = thermistor	X = socket
DL = delay line	L = inductor	S = switch	Y = crystal
DS = device signaling (lamp)	M = meter	T = transformer	

ABBREVIATIONS

A = amperes	GE = germanium	N/C = normally closed	RMO = rack mount only
A.F.C = automatic frequency control	GL = glass	NE = neon	RMS = root-mean-square
AMPL = amplifier	GRD = ground(ed)	NI PL = nickel plate	
		N/O = normally open	S-B = slow-blow
B. F. O. = beat frequency oscillator	H = henries	NPO = negative positive zero (zero temperature coefficient)	SCR = screw
BE CU = beryllium copper	HEX = hexagonal	NRFR = not recommended for field replacement	SE = selenium
BH = binder head	HG = mercury	NSR = not separately replaceable	SECT = section(s)
BP = bandpass	HR = hour(s)		SEMICON = semiconductor
BRS = brass			SI = silicon
BWO = backward wave oscillator	IF = intermediate freq		SIL = silver
	IMPG = impregnated		SL = slide
	INCD = incandescent		SPL = special
CCW = counter-clockwise	INCL = include(s)		SST = stainless steel
CER = ceramic	INS = insulation(ed)	OBD = order by description	SR = split ring
CMO = cabinet mount only	INT = internal	OH = oval head	STL = steel
COEF = coefficient		OX = oxide	
COM = common	K = kilo = 1000		
COMP = composition		P = peak	TA = tantalum
CONN = connector		PC = printed circuit	TD = time delay
CP = cadmium plate	LEN = linear taper	PF = picofarads = 10^{-12} farads	TGL = toggle
CRT = cathode-ray tube	LK WASH = lock washer	PH BRZ = phosphor bronze	TI = titanium
CW = clockwise	LOG = logarithmic taper	PHL = Phillips	TOL = tolerance
	LPF = low pass filter	PIV = peak inverse voltage	TRIM = trimmer
DEPC = deposited carbon		P/O = part of	TWT = traveling wave tube
DR = drive		POLY = polystyrene	
	M = milli = 10^{-3}	PORC = porcelain	U = micro = 10^{-6}
ELECT = electrolytic	MEG = meg = 10^{-6}	POS = position(s)	
ENCAP = encapsulated	METFLM = metal film	POT = potentiometer	VAR = variable
EXT = external	MFR = manufacturer	PP = peak-to-peak	VDCW = dc working volts
	MINAT = miniature	PT = point	
F = farads	MOM = momentary	RECT = rectifier	W/ = with
FH = flat head	MTG = mounting	RF = radio frequency	W = watts
FIL H = fillister head	MY = "mylar"	RH = round head	WW = wirewound
FXD = fixed	N = nano (10^{-9})		W/O = without

01194-9

Table 6-1. Reference Designation Index

Reference Designation	Stock No.	Description #	Note
A1	5232A-65F	ASSY:AMPLIFIER	
A1C1	0180-0039	C:FXD ELECT 100UF 12VDCW	
A1C2	0180-0124	C:FXD ELECT 200UF 6VDCW	
A1C3	0180-0061	C:FXD ELECT 100UF +100%-10% 15VDCW	
A1C4	0180-0050	C:FXD ELECT 40UF -15%+100% 50VDCW	
A1CR1	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A1Q1	1854-0003	TRANSISTOR:NPN SILICON	
A1Q2	1850-0091	TRANSISTOR:GERMANIUM 2N2048 PNP	
A1Q3	1850-0091	TRANSISTOR:GERMANIUM 2N2048 PNP	
A1Q4	1850-0091	TRANSISTOR:GERMANIUM 2N2048 PNP	
A1R1	0683-2735	R:FXD COMP 27K OHMS 5% 1/4W	
A1R2	0683-5615	R:FXD COMP 560 OHMS 5% 1/4W	
A1R3	0683-2735	R:FXD COMP 27K OHMS 5% 1/4W	
A1R4	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	
A1R5	0683-3915	R:FXD COMP 390 OHMS 5% 1/4W	
A1R6	0683-1825	R:FXD COMP 1800 OHMS 5% 1/4W	
A1R7	0683-2735	R:FXD COMP 27K OHMS 5% 1/4W	
A1R8	0686-1525	R:FXD COMP 1500 OHMS 5% 1/2W	
A1R9	0683-3315	R:FXD COMP 330 OHMS 5% 1/4W	
A1R10	0683-1225	R:FXD COMP 1200 OHMS 5% 1/4W	
A1R11	0683-1025	R:FXD COMP 1000 OHMS 5% 1/4W	
A1R12	0683-1835	R:FXD COMP 18K OHMS 5% 1/4W	
A1R13	0683-1025	R:FXD COMP 1000 OHMS 5% 1/4W	
A2	5232A-65E	ASSY:TRIGGER	
A2C1	0180-0094	C:FXD ELECT 100UF 25VDCW	
A2C2	0140-0193	C:FXD MICA 82 PF 5% 300 VDCW	
A2CR1	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A2CR2	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A2L1	9140-0029	COIL:RF CHOKE 100UH 2.6 OHMS	
A2Q1	1850-0029	TRANSISTOR:GERMANIUM 2N384	
A2Q2	1850-0029	TRANSISTOR:GERMANIUM 2N384	
A2R1	0683-3315	R:FXD COMP 330 OHMS 5% 1/4W	
A2R2	2100-0154	R:COMP 1000 OHM 30% LIN 3/10W	
A2R3	0683-1835	R:FXD COMP 18K OHMS 5% 1/4W	
A2R4	0686-1825	R:FXD COMP 1800 OHM 5% 1/2W	
A2R5	0683-4705	R:FXD COMP 47 OHMS 5% 1/4W	
A2R6	0683-8225	R:FXD COMP 8200 OHMS 5% 1/4W	
A2R7	0683-1225	R:FXD COMP 1200 OHMS 5% 1/4W	
A2R8	0686-9115	R:FXD COMP 910 OHMS 5% 1/2W	
A2R9	0686-9115	R:FXD COMP 910 OHMS 5% 1/2W	
A3	5232A-4C	ASSY:DECIMAL COUNTER(5232A ONLY)	
A3	5532A-4C	ASSY:DECIMAL COUNTER 5532A ONLY	
A3C1	0140-0191	C:FXD MICA 56 PF 5% 300 VDCW	
A3C2	0140-0145	C:FXD MICA 22 PF 5% 500 VDCW	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A3C3	0150-0122	CIFXD CER 2000PF 20% 500VDCW	
A3C4	0140-0145	CIFXD MICA 22 PF 5% 500 VDCW	
A3C5	0160-0179	CIFXD MICA 33PF 5% 300VDCW	
A3C6	0140-0190	CIFXD MICA 39 PF 5% 300 VDCW	
A3C7	0150-0122	CIFXD CER 2000PF 20% 500VDCW	
A3C8	0140-0190	CIFXD MICA 39 PF 5% 300 VDCW	
A3C9	0140-0190	CIFXD MICA 39 PF 5% 300 VDCW	
A3C10	0140-0204	CIFXD MICA 47PF 5% NPO 500VDCW	
A3C11		NOT ASSIGNED	
A3C12	0140-0204	CIFXD MICA 47PF 5% NPO 500VDCW	
A3C13	0140-0205	CIFXD MICA 62PF 5% 300VDCW	
A3C14	0140-0204	CIFXD MICA 47PF 5% NPO 500VDCW	
A3C15	0140-0192	CIFXD MICA 68PF 5% 300VDCW	
A3C16	0140-0145	CIFXD MICA 22 PF 5% 500 VDCW	
A3C17	0140-0193	CIFXD MICA 82 PF 5% 300 VDCW	
A3CR1	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A3CR2	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A3CR3	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A3CR4	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A3CR5	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A3CR6	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A3CR7	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A3CR8	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A3CR9	1910-0021	SEMICON DEVICE:DIODE	
A3CR10	1901-0040	SEMICON DEVICE:DIODE SILICON	
A3CR11	1910-0021	SEMICON DEVICE:DIODE	
A3CR12	1910-0021	SEMICON DEVICE:DIODE	
A3CR13	1910-0021	SEMICON DEVICE:DIODE	
A3CR14	1901-0040	SEMICON DEVICE:DIODE SILICON	
A3CR15	1910-0021	SEMICON DEVICE:DIODE	
A3CR16	1910-0021	SEMICON DEVICE:DIODE	
A3CR17	1910-0021	SEMICON DEVICE:DIODE	
A3CR18	1910-0021	SEMICON DEVICE:DIODE	
A3CR19	1910-0021	SEMICON DEVICE:DIODE	
A3CR20	1910-0021	SEMICON DEVICE:DIODE	
A3DS1	2140-0044	LAMP:NEON SELECTED MATCHED PAIR NOT RECOMMENDED FOR FIELD REPLACEMENT	
A3DS2	2140-0044	LAMP:NEON SELECTED MATCHED PAIR NOT RECOMMENDED FOR FIELD REPLACEMENT	
A3DS3	2140-0044	LAMP:NEON SELECTED MATCHED PAIR NOT RECOMMENDED FOR FIELD REPLACEMENT	
A3DS4	2140-0044	LAMP:NEON SELECTED MATCHED PAIR NOT RECOMMENDED FOR FIELD REPLACEMENT	
A3DS5	2140-0022	LAMP:GLOW NE-2E NEON	
A3DS6	2140-0022	LAMP:GLOW NE-2E NEON 5232 ONLY	
A3DS6	1970-0002	INDICATOR:10 DIGIT 5532A ONLY 5532A ONLY	
A3DS7	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	
A3DS8	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	
A3DS9	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A3DS10	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	
A3DS11	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	
A3DS12	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	
A3DS13	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	
A3DS14	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	
A3DS15	2140-0022	LAMP:GLOW NEON NE2E (5232 ONLY)	
A3Q1	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A3Q2	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A3Q3	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A3Q4	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A3Q5	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A3Q6	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A3Q7	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A3Q8	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A3R1	0683-2745	R:FXD COMP 270K OHMS 5% 1/4W FOR 5232A ONLY	
A3R1	0686-4735	R:FXD COMP 47K OHM 5% 1/2W FOR 5532A ONLY	
A3R1	0845-0001	NETWORK:RESISTIVE(10 RESISTORS) NOT RECOMMENDED FOR FIELD REPLACEMENT	
A3R2	0683-1055	R:FXD COMP 1M OHM 5% 1/4W 5232A ONLY	
A3R3	0683-8235	R:FXD COMP 82K OHMS 5% 1/4W 5232A ONLY	
A3R4	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W 5232A ONLY	
A3R5	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A3R6	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A3R7	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A3R8	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A3R9	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A3R10	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A3R11	0683-5635	R:FXD COMP 56K OHMS5%11/4W	
A3R12	0683-5635	R:FXD COMP 56K OHMS5%11/4W	
A3R13	0683-5635	R:FXD COMP 56K OHMS5%11/4W	
A3R14	0683-5635	R:FXD COMP 56K OHMS5%11/4W	
A3R15	0683-5635	R:FXD COMP 56K OHMS5%11/4W	
A3R16	0683-5635	R:FXD COMP 56K OHMS5%11/4W	
A3R17	0683-5635	R:FXD COMP 56K OHMS5%11/4W	
A3R18	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
A3R19	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A3R20	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A3R21	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
A3R22	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
A3R23	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R24	0683-5605	R:FXD COMP 56 OHM 5% 1/4W	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A3R25	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
A3R26	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
A3R27	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A3R28	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A3R29	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
A3R30	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A3R31	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A3R32	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
A3R33	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R34	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
A3R35	0683-5605	R:FXD COMP 56 OHM 5% 1/4W	
A3R36	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
A3R37	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A3R38	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A3R39	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A3R40	0683-1835	R:FXD COMP 18K OHMS 5% 1/4W	
A3R41	0683-1825	R:FXD COMP 1800 OHMS 5% 1/4W	
A3R42	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	
A3R43	0683-2235	R:FXD COMP 22K OHMS 5% 1/4W	
A3R44	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
A3R45	0683-7505	R:FXD COMP 75 OHM 5% 1/4W	
A3R46	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A3R47	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
A3R48	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A3R49	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R50	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R51	0683-5635	R:FXD COMP 56K OHM 5% 1/4W	
A3R52	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	
A3R53	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A3R54	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R55	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R56	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
A3R57	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A3R58	0683-7505	R:FXD COMP 75 OHM 5% 1/4W	
A3R59	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A3R60	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A3R61	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R62	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R63	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
A3R64	0683-9115	R:FXD COMP 910 OHM 5% 1/4W	
A3V1	1990-0009	PHOTOCONDUCTOR MULTIPLE 4-10 LINE CONVERS. NOT RECOMMENDED FOR FIELD REPLACEMENT	
A4	5212A-4A	ASSY:DECIMAL COUNTER(5232A ONLY)	
A4	5512A-4A	ASSY:DECIMAL COUNTER(5532A ONLY)	
A4	5214L-6015	ASSY:OSCILLATOR BOARD	
A4C1	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A4C2	0140-0217	C:FXD MICA 140PF 2% 300VDCW	
A4C3	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A4C4	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A4C5	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A4C6	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A4C7	0140-0198	C:FXD MICA 200 PF 5% 300 VDCW	
A4C8	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A4C9	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A4C10	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A4C11	0140-0198	C:FXD MICA 200 PF 5% 300 VDCW	
A4C12	0140-0198	C:FXD MICA 200 PF 5% 300 VDCW	
A4C13	0140-0199	C:FXD MICA 240 PF 5% 300 VDCW	
A4CR1	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A4CR2	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A4CR3	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A4CR4	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A4CR5	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A4CR6	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A4CR7	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A4CR8	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A4CR9	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A4CR10	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A4CR11	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A4CR12	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A4CR13	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A4DS1	2140-0044	LAMP:NEON SELECTED MATCHED PAIR NOT RECOMMENDED FOR FIELD REPLACEMENT	
A4DS2	2140-0044	LAMP:NEON SELECTED MATCHED PAIR NOT RECOMMENDED FOR FIELD REPLACEMENT	
A4DS3	2140-0044	LAMP:NEON SELECTED MATCHED PAIR NOT RECOMMENDED FOR FIELD REPLACEMENT	
A4DS4	2140-0044	LAMP:NEON SELECTED MATCHED PAIR NOT RECOMMENDED FOR FIELD REPLACEMENT	
A4DS5	2140-0022	LAMP:GLOW NE-2E NEON	
A4DS6	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS6	1970-0002	INDICATOR 10 DIGIT 5532A ONLY	
A4DS7	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS8	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS9	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS10	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS11	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS12	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS13	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS14	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4DS15	2140-0022	LAMP:GLOW NE-2E NEON (5232 ONLY)	
A4Q1	1850-0062	TRANSISTOR: SPL2N404A	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A4Q2	1850-0062	TRANSISTOR: SPL2N404A	
A4Q3	1850-0062	TRANSISTOR: SPL2N404A	
A4Q4	1850-0062	TRANSISTOR: SPL2N404A	
A4Q5	1850-0062	TRANSISTOR: SPL2N404A	
A4Q6	1850-0062	TRANSISTOR: SPL2N404A	
A4Q7	1850-0062	TRANSISTOR: SPL2N404A	
A4Q8	1850-0062	TRANSISTOR: SPL2N404A	
A4R1	0683-2745	R:FXD COMP 270K OHMS 5% 1/4W (5232 ONLY)	
A4R1	0686-4735	R:FXD COMP 47K OHM 5% 1/2W FOR 5532A ONLY	
A4R2	0845-0001	R:NETWORK 270K 20% 1/4W NOT RECOMMENDED FOR FIELD REPLACEMENT	
A4R3	0683-1055	R:FXD COMP 1 MEGOHM 5% 1/4W	
A4R4	0683-8235	R:FXD COMP 82K OHMS 5% 1/4W	
A4R5	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W FOR 5232A-4A ONLY	
A4R6	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A4R7	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A4R8	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A4R9	0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	
A4R10	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A4R11	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A4R12	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A4R13	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A4R14	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A4R15	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A4R16	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A4R17	0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	
A4R18	0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	
A4R19	0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	
A4R20	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A4R21	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	
A4R22	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A4R23	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A4R24	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
A4R25	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A4R26	0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	
A4R27	0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	
A4R28	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A4R29	0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	
A4R30	0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	
A4R31	0683-8225	R:FXD COMP 8200 OHMS 5% 1/4W	
A4R32	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	
A4R33	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A4R34	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A4R35	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
A4R36	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A4R37	0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	
A4R38	0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A4R39	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A4R40	0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	
A4R41	0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	
A4R42	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A4R43	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	
A4R44	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A4R45	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A4R46	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
A4R47	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A4R48	0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	
A4R49	0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	
A4R50	0683-8225	R:FXD COMP 8200 OHMS 5% 1/4W	
A4R51	0683-6835	R:FXD COMP 68KOP-M5%11/ W	
A4R52	0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	
A4R53	0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	
A4R54	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A4R55	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	
A4R56	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A4R57	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A4R58	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
A4R59	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A4R60	0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	
A4R61	0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	
A4R62	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A4V1	1990-0009	PHOTOCONDUCTOR MULTIPLE 4-10 LINE CONVERS. NOT RECOMMENDED FOR FIELD REPLACEMENT	
A5		SAME AS A4:USE PREFIX A5.	
A6		SAME AS A4:USE PREFIX A6.	
A7		SAME AS A4:USE PREFIX A7.	
A8		SAME AS A4:USE PREFIX A8.	
A9	5232A-650	ASSY:OSCILLATOR	
A9C1	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A9C2	0140-0070	C:FXD MICA 0.01 UF 1% 300 VDCW	
A9C3	0140-0152	C:FXD MICA 1000PF 5% 300VDCW	
A9C4	0160-0127	C:FXD 1UF 20% 25VDCW	
A9C5	0180-0049	C:FXD ELECT 20UF 50VDCW	
A9C6	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A9C7	0140-0156	C:FXD MICA 1500 PF 2% 300 VDCW	
A9C8	0160-0127	C:FXD 1UF 20% 25VDCW	
A9C9	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A9C10	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A9C11	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A9C12	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A9C13	0170-0072	C:FXD MY 1UF 10% 200VDCW	
A9C14	0140-0200	C:FXD MICA 390PF 5% 300CDCW	
A9C15	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A9CR1	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A9CR2	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A9CR3	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A9L1	9140-0029	COIL:RF CHOKE 100UH 2.6 OHMS	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A9L2	9140-0029	COIL:RF CHOKE 100UH 2.6 OHMS	
A9Q1	1850-0029	TRANSISTOR:GERMANIUM 2N384	
A9Q2	1850-0029	TRANSISTOR:GERMANIUM 2N384	
A9Q3	1850-0029	TRANSISTOR:GERMANIUM 2N384	
A9Q4	1850-0029	TRANSISTOR:GERMANIUM 2N384	
A9R1	0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	
A9R2	0683-2725	R:FXD COMP 2700 OHMS 5% 1/4W	
A9R3		NOT ASSIGNED	
A9R4	0680-3925	R:FXD COMP 3900 OHM 5% 1/4W	
A9R5	0683-3325	R:FXD COMP 330 OHMS 5% 1/4W	
A9R6	0683-1135	R:FXD COMP 11K OHM 5% 1/4W	
A9R7	0683-3325	R:FXD COMP 330 OHMS 5% 1/4W	
A9R8	0683-4325	R:FXD COMP 4300 OHMS 5% .25W	
A9R9	0683-1325	R:FXD COMP 1300 OHMS 5% 1/4W	
A9R10	0683-2435	R:FXD COMP 24K OHMS 5% 1/4W	
A9R11	0683-8225	R:FXD COMP 8200 OHMS 5% 1/4W	
A9R12	0683-2425	R:FXD COMP 2400 OHMS 5% 1/4W	
A9R13	0683-1525	R:FXD COMP 150 OHMS 5% 1/4W	
A9R14	0683-1835	R:FXD COMP 18K OHMS 5% 1/4W	
A9R15	0683-8215	R:FXD COMP 820 OHMS 5% 1/4W	
A9R16	0689-1825	R:FXD COMP 1800 OHMS 5% 1W	
A9R17	0683-6205	R:FXD COMP 62 OHMS 5% 1/4W	
A9R18	0683-8225	R:FXD COMP 8200 OHMS 5% 1/4W	
A9R19	0683-9115	R:FXD COMP 910 OHMS 5% 1/4W	
A10	5232A-65H	ASSY:DECADE DIVIDER	
A10C1	0140-0191	C:FXD MICA 56 PF 5% 300 VDCW	
A10C2	0140-0191	C:FXD MICA 56 PF 5% 300 VDCW	
A10C3	0150-0121	C:FXD CER 0.1UF 50 VDCW	
A10C4	0160-0179	C:FXD MICA 33PF 5% 300VDCW	
A10C5	0150-0122	C:FXD CER 2000PF 20% 500VDCW	
A10C6	0140-0191	C:FXD MICA 56 PF 5% 300 VDCW	
A10C7	0160-0196	C:FXD MICA 24PF 5% 300VDCW	
A10C8	0140-0191	C:FXD MICA 56 PF 5% 300 VDCW	
A10C9	0150-0122	C:FXD CER 2000PF 20% 500VDCW	
A10C10	0140-0191	C:FXD MICA 56 PF 5% 300 VDCW	
A10C11	0140-0192	C:FXD MICA 68PF 5% 300VDCW	
A10C12	0140-0205	C:FXD MICA 62PF 5% 300VDCW	
A10C13	0140-0205	C:FXD MICA 62PF 5% 300VDCW	
A10C14	0140-0191	C:FXD MICA 56 PF 5% 300 VDCW	
A10C15	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A10C16	0140-0192	C:FXD MICA 68PF 5% 300VDCW	
A10C17	0140-0196	C:FXD MICA 150 PF 5% 300 VDCW	
A10CR1	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR2	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR3	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR4	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR5	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR6	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A10CR7	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR8	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR9	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR10	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10CR11	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10Q1	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A10Q2	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A10Q3	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A10Q4	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A10Q5	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A10Q6	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A10Q7	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A10Q8	1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	
A10R1	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A10R2	0758-0024	R:FXD MET FLM 100 OHM 5% 1/2W	
A10R3	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
A10R4	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A10R5	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A10R6	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R7	0683-6205	R:FXD COMP 62 OHM 5% 1/4W	
A10R8	0683-5605	R:FXD COMP 56 OHM 5% 1/4W	
A10R9	0683-6205	R:FXD COMP 62 OHM 5% 1/4W	
A10R10	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R11	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
A10R12	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A10R13	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A10R14	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
A10R15	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A10R16	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A10R17	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R18	0683-6205	R:FXD COMP 62 OHM 5% 1/4W	
A10R19	0683-5605	R:FXD COMP 56 OHM 5% 1/4W	
A10R20	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A10R21	0683-6205	R:FXD COMP 62 OHM 5% 1/4W	
A10R22	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R23	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
A10R24	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A10R25	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
A10R26	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A10R27	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A10R28	0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	
A10R29	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R30	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
A10R31	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A10R32	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A10R33	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
A10R34	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R35	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A10R36	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A10R37	0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A10R38	0683-5635	R:FXD COMP 56K OHM 5% 1/4W	
A10R39	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	
A10R40	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A10R41	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A10R42	0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	
A10R43	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R44	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A10R45	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A10R46	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R47	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A10R48	0683-1635	R:FXD COMP 16K OHM 5% 1/4W	
A10R49	0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	
A11	5212A-65C	ASSY:DECADE DIVIDER	
A11C1	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A11C2	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A11C3	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A11C4	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A11C5	0140-0196	C:FXD MICA 150 PF 5% 300 VDCW	
A11C6	0140-0196	C:FXD MICA 150 PF 5% 300 VDCW	
A11C7	0140-0196	C:FXD MICA 150 PF 5% 300 VDCW	
A11C8	0140-0199	C:FXD MICA 240 PF 5% 300 VDCW	
A11C9	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A11C10	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
A11C11	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A11C12	0140-0198	C:FXD MICA 200 PF 5% 300 VDCW	
A11C13	0140-0198	C:FXD MICA 200 PF 5% 300 VDCW	
A11C14	0140-0200	C:FXD MICA 390PF 5% 300VDCW	
A11CR1	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A11CR2	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A11CR3	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A11CR4	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A11CR5	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
A11Q1	1850-0062	TRANSISTOR:GERMANIUM	
A11Q2	1850-0062	TRANSISTOR:GERMANIUM	
A11Q3	1850-0062	TRANSISTOR:GERMANIUM	
A11Q4	1850-0062	TRANSISTOR:GERMANIUM	
A11Q5	1850-0062	TRANSISTOR:GERMANIUM	
A11Q6	1850-0062	TRANSISTOR:GERMANIUM	
A11Q7	1850-0062	TRANSISTOR:GERMANIUM	
A11Q8	1850-0062	TRANSISTOR:GERMANIUM	
A11R1	0683-3915	R:FXD COMP 390 OHMS 5% 1/4W	
A11R2	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R3	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	
A11R4	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R5	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A11R6	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A11R7	0683-2015	R:FXD COMP 200 OHMS 5% 1/4W	
A11R8	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A11R9	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A11R10	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R11	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A11R12	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R13	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R14	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	
A11R15	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R16	0683-8225	R:FXD COMP 8200 OHMS 5% 1/4W	
A11R17	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A11R18	0683-2015	R:FXD COMP 200 OHMS 5% 1/4W	
A11R19	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A11R20	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	
A11R21	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R22	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A11R23	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R24	0683-6835	R:FXD COMP 68K 5% 1/4W	
A11R25	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R26	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	
A11R27	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R28	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A11R29	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A11R30	0683-2015	R:FXD COMP 200 OHMS 5% 1/4W	
A11R31	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A11R32	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	
A11R33	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R34	0683-8225	R:FXD COMP 8200 OHMS 5% 1/4W	
A11R35	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R36	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R37	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	
A11R38	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R39	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A11R40	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A11R41	0683-2015	R:FXD COMP 200 OHMS 5% 1/4W	
A11R42	0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	
A11R43	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	
A11R44	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A11R45	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A11R46	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A12		SAME AS A11. USE PREFIX A12.	
A13		SAME AS A11. USE PREFIX A13.	
A14		SAME AS A11. USE PREFIX A14.	
A15		SAME AS A11. USE PREFIX A15.	
A16		SAME AS A11. USE PREFIX A16.	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A17	5212A-65D	ASSY:CONTROL GATE	
A17C1	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A17C2	0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	
A17C3	0140-0200	C:FXD MICA 390PF 5% 300CDCW	
A17C4	0140-0200	C:FXD MICA 390PF 5% 300CDCW	
A17C5	0140-0198	C:FXD MICA 200 PF 5% 300 VDCW	
A17C6	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A17CR1	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A17CR2	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A17CR3	1910-0011	DIODE:GERMANIUM SMA AT 1V 60 PIV	
A17CR4	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A17CR5	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A17CR6	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A17CR7	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A17DS1	2140-0022	LAMP:GLOW NE-2E NEON	
A17Q1	1850-0062	TRANSISTOR:GERMANIUM	
A17Q2	1850-0062	TRANSISTOR:GERMANIUM	
A17Q3	1851-0006	TRANSISTOR:2N169A NPN	
A17Q4	1850-0040	TRANSISTOR:GERMANIUM 2N383 PNP	
A17Q5	1850-0040	TRANSISTOR:GERMANIUM 2N383 PNP	
A17R1	0761-0005	R:FXD MET OX 2200 OHM 5% 1W	
A17R2	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A17R3	0683-2235	R:FXD COMP 22K OHMS 5% 1/4W	
A17R4	0683-4725	R:FXD COMP 4700 OHM 5% 1/4W	
A17R5	0683-4725	R:FXD COMP 4700 OHMS 5% 1/4W	
A17R6	0683-2235	R:FXD COMP 22K OHMS 5% 1/4W	
A17R7	0761-0005	R:FXD MET OX 2200 OHM 5% 1W	
A17R8	0683-2705	R:FXD COMP 27 OHMS 5% 1/4W	
A17R9	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A17R10	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A17R11	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont d)

Reference Designation	Stock No.	Description #	Note
A17R12	0683-2435	R:FXD COMP 24K OHMS 5% 1/4W	
A17R13		NOT ASSIGNED	
A17R14	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A17R15	0683-2225	R:FXD COMP 2200 OHMS 5% 1/4W	
A17R16	0683-3335	R:FXD COMP 33K OHMS 5% 1/4W	
A17R17	0683-3335	R:FXD COMP 33K OHMS 5% 1/4W	
A17R18	0683-4725	R:FXD COMP 4700 OHMS 5% 1/4W	
A17R19	0686-6825	R:FXD COMP 6800 OHMS 5% 1/2W	
A17R20	0683-3335	R:FXD COMP 33K OHMS 5% 1/4W	
A17R21	0683-2745	R:FXD COMP 270K OHMS 5% 1/4W	
A17R22	0683-3345	R:FXD COMP 330K OHMS 5% 1/4W	
A17R23	0683-1045	R:FXD COMP 100K OHMS 5% 1/4W	
A17R24	0683-2735	R:FXD COMP 27K OHMS 5% 1/4W	
A17V1	2140-0022	LAMP:GLOW NE-2E NEON	
A18	5212A-65E	ASSY:DISPLAY CONTROL	
A18C1	0140-0149	C:FXD MICA 470 PF 5% 300 VDCW	
A18C2	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A18C3	0180-0116	C:FXD ELECT TA 6.8UF 10% 35VDCW	
A18C4	0140-0200	C:FXD MICA 390PF 5% 300CDCW	
A18C5	0140-0200	C:FXD MICA 390PF 5% 300CDCW	
A18C6	0150-0014	C:FXD CER 5000PF MIN 500VDCW	
A18C7	0140-0152	C:FXD MICA 1000PF 5% 300VDCW	
A18C8	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A18C9	0150-0014	C:FXD CER 5000PF MIN 500VDCW	
A18C10	0180-0049	C:FXD ELECT 20UF 50VDCW	
A18CR1	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A18CR2	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A18CR3	1910-0011	DIODE:GERMANIUM 5MA AT 1V 60 PIV	
A18CR4	1910-0011	DIODE:GERMANIUM 5MA AT 1V 60 PIV	
A18CR5	1910-0011	DIODE:GERMANIUM 5MA AT 1V 60 PIV	
A18CR6	1910-0011	DIODE:GERMANIUM 5MA AT 1V 60 PIV	
A18CR7	1902-0223	SEMICON DEVICE:DIODE SILICON	
A18CR8	1901-0025	SEMICON DEVICE:DIODE JUNCTION	
A18Q1	1850-0062	TRANSISTOR:SPL2N404A	
A18Q2	1850-0062	TRANSISTOR:SPL2N404A	
A18Q3	1850-0062	TRANSISTOR:SPL2N404A	
A18Q4	1850-0062	TRANSISTOR:SPL2N404A	
A18Q5	1850-0062	TRANSISTOR:SPL2N404A	
A18Q6	1850-0040	TRANSISTOR:GERMANIUM 2N383 PNP	
A18Q7	1851-0024	TRANSISTOR:GERMANIUM 2N388A NPN	
A18R1	0686-5625	R:FXD COMP 5600 OHMS 5% 1/2W	
A18R2	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A18R3	0683-3325	R:FXD COMP 3300 OHM 5% 1/4W	
A18R4	0683-3325	R:FXD COMP 3300 OHM 5% 1/4W	
A18R5	0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	
A18R6	0686-5625	R:FXD COMP 5600 OHMS 5% 1/2W	
A18R7	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
A18R8	0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A18R9	0683-1535	R:FXD COMP 15K OHMS 5% 1/4W	
A18R10	0683-2235	R:FXD COMP 22K OHMS 5% 1/4W	
A18R11	0686-5625	R:FXD COMP 5600 OHMS 5% 1/2W	
A18R12	0683-3325	R:FXD COMP 330 OHMS 5% 1/4W	
A18R13	0683-1535	R:FXD COMP 15K OHMS 5% 1/4W	
A18R14	0683-2435	R:FXD COMP 24K OHMS 5% 1/4W	
A18R15	0683-3915	R:FXD COMP 390 OHMS 5% 1/4W	
A18R16	0683-2225	R:FXD COMP 2200 OHMS 5% 1/4W	
A18R17	0683-2735	R:FXD COMP 27K OHMS 5% 1/4W	
A18R18	0683-2725	R:FXD COMP 2700 OHMS 5% 1/4W	
A18R19	0683-2225	R:FXD COMP 2200 OHMS 5% 1/4W	
A18R20	0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	
A18R21	0686-1025	R:FXD COMP 1000 OHMS 5% 1/5W	
A18R22	0683-6835	R:FXD COMP 68K OHM 5% 1/4W	
A18R23	0683-4725	R:FXD COMP 4700 OHMS 5% 1/4W	
A19	5212A-65G	ASSY:POWER SUPPLY	
A19C1	0170-0024	C:FXD MY 0.022UF 20% 200VDCW	
A19C2	0180-0050	C:FXD ELECT 40UF -15%+100% 50VDCW	
A19C3	0180-0050	C:FXD ELECT 40UF -15%+100% 50VDCW	
A19CR1	1901-0028	DIODE:SILICON PIV 400V I AVGE 0.75A	
A19CR2	1901-0028	DIODE:SILICON PIV 400V I AVGE 0.75A	
A19CR3	1901-0028	DIODE:SILICON PIV 400V I AVGE 0.75A	
A19CR4	1901-0028	DIODE:SILICON PIV 400V I AVGE 0.75A	
A19CR5	1901-0028	DIODE:SILICON PIV 400V I AVGE 0.75A	
A19CR6	1901-0028	DIODE:SILICON PIV 400V I AVGE 0.75A	
A19CR7	1901-0028	DIODE:SILICON PIV 400V I AVGE 0.75A	
A19CR8	1901-0028	DIODE:SILICON PIV 400V I AVGE 0.75A	
A19CR9	1902-0148	SEMICON DEVICE:DIODE SILICON	
A19Q1	1850-0062	TRANSISTOR:GERMANIUM	
A19R1	0689-3625	R:FXD COMP 3600 OHMS 5% 1W	
A19R2	0683-1245	R:FXD COMP 120K OHMS 5% 1/4W	
A19R3	0683-1235	R:FXD COMP 12K OHMS 5% 1/4W	
A19R4	0683-1025	R:FXD COMP 1000 OHMS 5% 1/4W	
A19R5	0813-0019	R:FXD WW 0.47 OHM 10% 1/2W	
A19R6	0689-2225	R:FXD COMP 2200 OHM 5% 1W	
A19R7	2100-0128	R:VAR COMP 250 OHMS 20% LIN 1/3W	
A19R8	0683-4715	R:FXD COMP 470 OHMS 5% 1/4W	
A19R9	0683-1225	R:FXD COMP 1200 OHMS 5% 1/4W	
A19R10	0686-3625	R:FXD COMP 3600 OHMS 5% 1/2W	
A19R11	0683-3615	R:FXD COMP 360 OHMS 5% 1/4W	
A19R12	0683-4705	R:FXD COMP 47 OHMS 5% 1/4W	
A19R13	0683-4705	R:FXD COMP 47 OHMS 5% 1/4W	
B1	3140-0030 5212A-12B 3160-0027	MOTOR:FAN 115V 60 CYCLE BRACKET:FAN BLADE:FAN 2-1/4 IN DIAM	
C4	0150-0021	C:FXD TI 0.47PF 5% 500VDCW	
C5		NOT ASSIGNED	
C6	0150-0031	C:FXD TI 2PF 5% 500VDCW	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
C7	0150-0047	C:FXD TI 6.8 PF 10% 500 VDCW	
C8	0140-0101	C:FXD MICA 15PF 5% 500 VDCW	
C9	0140-0144	C:FXD MICA 18 PF .5% 500VDCW	
C10	0130-0001	C:VAR 7-45PF 500VDCW	
C10	5212A-47A	SPACER:CAPACITOR	
C11	0150-0033	C:FXD TI 8.2 PF 10% 500 VDCW	
C12	0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	
C13	0140-0081	C:FXD MICA 56PF +/-1PF	
C14	0170-0073	C:FXD MY 1UF 10% 600VDCW	
C15	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
C16	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
C17	0180-0047	C:FXD ELECT 500UF 75VDCW	
C17	1520-0001	MOUNTING PLATE:CAPACITOR	
C18	0180-0107	C:FXD ELECT 20UF -10/+100% 200VDCW	
C19	0180-0107	C:FXD ELECT 20UF -10/+100% 200VDCW	
C20	0180-0059	C:FXD ELECT 10UF 25VDCW+100-10%	
C21	0150-0119	C:FXD CER 2X(.01UF) 20% 250VDCW	
C22	0140-0179	C:FXD MICA 1000 PF 2% 300 VDCW	
CR1	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
DS1	1450-0042	INDICATOR:LIGHT NE2E	
F1	2110-0001	FUSE:1 AMP 115 VOLT OPERATION	
	2110-0012	FUSE:5AMP 230 VOLT OPERATION	
	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
F2	2110-0033	FUSE:0.75 AMP	
J1	1250-0118	CONNECTOR:BNC	
J2	1250-0083	CONNECTOR:BNC	
J3	1251-0148	CONNECTOR:POWER	
J4	1251-0087	CONNECTOR:FEMALE 50 PIN MINAT.	
L1	9140-0115	COIL:FXD 22UH	
L2	9140-0115	COIL:FXD 22UH	
Q1	1850-0070	TRANSISTOR:GERMANIUM 2N1373	
	1205-0025	NUT:HEAT DISSIPATOR	
	1205-0026	BODY:HEAT DISSIPATOR	
Q2	1850-0068	TRANSISTOR:GERMANIUM 2N1136 PNP	
	1200-0043	INSULATOR:TRANSISTOR	
	0340-0039	INSULATOR:TERMINAL POST	
	1200-0044	SOCKET:TRANSISTOR	
	1200-0081	INSULATOR:BUSHING NYLON (2)	
	0340-0038	TERMINAL:STUD	
R2	0683-1255	R:FXD COMP 1.2 MEGOHM 5% 1/4W	
R3	0683-1235	R:FXD COMP 12K OHMS 5% 1/4W	
R4	0683-1255	R:FXD COMP 1.2 MEGOHM 5% 1/4W	
R5	0683-3935	R:FXD COMP 39K OHMS 5% 1/4W	
R6	0683-1055	R:FXD COMP 1 MEGOHM 5% 1/4W	
R7	0683-1245	R:FXD COMP 120K OHMS 5% 1/4W	
R8	0683-8245	R:FXD COMP 820K OHMS 5% 1/4W	
R9	0683-5645	R:FXD COMP 560K OHMS 5% 1/4W	
R10	0686-5115	R:FXD COMP 510 OHMS 5% 1/2W	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

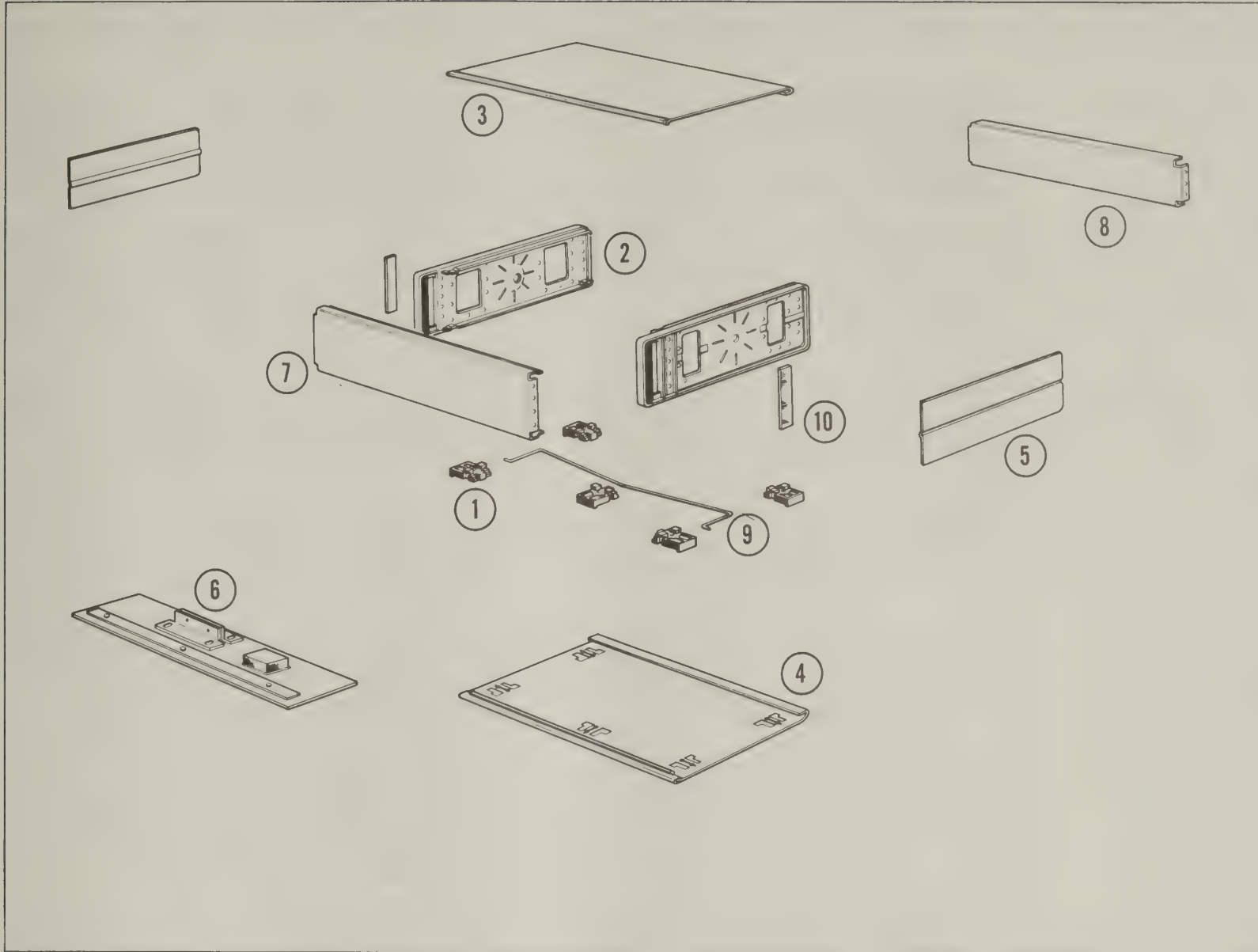
Reference Designation	Stock No.	Description #	Note
R11	0683-2245	R:FXD COMP 220K OHM 5% 1/4W	
R12	0683-5625	R:FXD COMP 5600 OHMS 5% 1/4W	
R13	0683-3355	R:FXD COMP 3.3 MEGOHM 5% 1/4W	
R14	0683-2735	R:FXD COMP 27K OHMS 5% 1/4W	
R15	0686-4725	R:FXD COMP 4700 OHMS 5% 1/2W	
R16	0683-6835	R:FXD COMP 68K OHM 5% 1/4W	
R17	0683-2735	R:FXD COMP 27K OHMS 5% 1/4W	
R18	0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	
R19	0683-3935	R:FXD COMP 39K OHMS 5% 1/4W	
R20	2100-0083	R:VAR COMP 250K OHMS 30% 20CLOG 1/4W	
R20	0370-0026	KNOB: DISPLAY INCLUDES S6	
R21	0816-0020	R:FXD WW 110 OHM 10% 10W	
R22	0684-2741	R:FXD COMP 270K OHMS 10% 1/4W	
S1	3100-0276 0370-0077	SWITCH:ROTARY 4 SECT 12 POS KNOB: FUNCTION	
S2	3100-0277 0370-0075	SWITCH ROTARY 2 SECT 6 POS KNOB SENSITIVITY	
S3	3101-0036	SWITCH:TOGGLE DPDT 3AMP 125V	
S4	3101-0037	SWITCH:TOGGLE SPST 3 AMP	
S5	3101-0010	SWITCH:PUSHBUTTON DPDT MOM ACTION	
S6		NOT SEPARATELY REPLACEABLE PART OF R20	
S7	3101-0036	SWITCH:TOGGLE SPST	
S8	3101-0033	SWITCH:SLIDE DPDT	
T1	9100-0139 5212A-12A	TRANSFORMER:POWER BRACKET:TRANSFORMER	
W1	8120-0078	CABLE POWER SVT-18-3 7.5FT.	
XA3	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA4	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA5	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA6	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA7	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA8	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA9	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA10	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA11	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA12	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA13	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA14	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA15	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA16	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA17	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA18	1251-0135	CONNECTOR:PRINTED CIRCUIT	
XA19	1251-0135	CONNECTOR:PRINTED CIRCUIT	
Y1	5232A-69A 5232A-12A	ASSY:CRYSTAL BRACKET:TERMINAL	

See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Ⓢ Stock No.	Description #	Note
	0340-0038	POST:TERMINAL	
		MISCELLANEOUS	
	5212A-85A	ASSY:AIR FILTER	
	10503A	CABLE ASSEMBLY	
	5060-0767	FOOT ASSEMBLY	
	5212A-41A	INSULATOR:BOTTOM COVER	
	5212A-44A	KIT:RACK MOUNTING	
	1490-0030	STAND:TILT	

See list of abbreviations in introduction to this section



ITEM NO.	DESCRIPTION	STOCK NO.	TQ
1	Assembly: Foot	5060-0767	5
2	Assembly: Frame	5060-0729	2
3	Cover: Top, unperforated, with screw holes	5060-0739	1
4	Cover: Bottom, unperforated, with screw holes	5060-0751	1
5	Cover: Side, perforated, with screw holes	5000-0729	2
6	Kit: rack mount adapter	5060-0774	1
7	Panel: Front, engraved	5232A-2A 5532A-2A	1
8	Panel: Rear, engraved	5212A-1H	1
9	Stand: Tilt	1490-0030	1
10	Trim: plastic	6980-0001	2

Figure 6-1. Modular Cabinet Parts

Table 6-2. Replaceable Parts

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ (a)	TQ (b)
0130-0001	C:VAR 7-45PF 500VDCW	72982	503000D2P0	1	1
0140-0070	C:FXD MICA 0.01 UF 1% 300 VDCW	14655	CM35E103F	1	1
0140-0081	C:FXD MICA 56PF +/-1PF	00853	DR1456E	1	1
0140-0101	C:FXD MICA 15PF 5% 500 VDCW	00853	RCM15C150J	1	1
0140-0123	C:FXD MICA 82 PF 5% 300 VDCW	04062	DM15E820J 300V	1	1
0140-0124	C:FXD MICA 110 PF 5% 300 VDCW	04062	DM15F111J 300V	1	1
0140-0125	C:FXD MICA 130 PF 5% 300 VDCW	04062	DM15F131J 300V	2	2
0140-0144	C:FXD MICA 18 PF 5% 500VDCW	00853	RCM15C180E	1	1
0140-0145	C:FXD MICA 22 PF 5% 500 VDCW	04062	DM15C220J	3	3
0140-0149	C:FXD MICA 470 PF 5% 300 VDCW	04062	DM15F471J	1	1
0140-0152	C:FXD MICA 1000PF 5% 300VDCW	72136	DM16F102J	2	2
0140-0156	C:FXD MICA 1500 PF 2% 300 VDCW	04062	DM19F152G 300V	1	1
0140-0179	C:FXD MICA 1000 PF 2% 300 VDCW	04062	DM19F102G 300V	1	1
0140-0190	C:FXD MICA 39 PF 5% 300 VDCW	04062	DM15E390J 300V	3	3
0140-0191	C:FXD MICA 56 PF 5% 300 VDCW	04062	DM15E560J 300V	7	7
0140-0192	C:FXD MICA 68PF 5% 300VDCW	04062	DM15E680J	3	3
0140-0193	C:FXD MICA 82 PF 5% 300 VDCW	04062	DM15E620J 300V	1	1
0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	04062	DM15F111J 300V	5	5
0140-0194	C:FXD MICA 110 PF 5% 300 VDCW	04062	DM15F111J 300V	39	39
0140-0195	C:FXD MICA 130 PF 5% 300 VDCW	04062	DM15F131J 300V	34	34
0140-0196	C:FXD MICA 150 PF 5% 300 VDCW	04062	DM15F151J 300V	19	19
0140-0198	C:FXD MICA 200 PF 5% 300 VDCW	04062	DM15F201J 300V	28	28
0140-0199	C:FXD MICA 240 PF 5% 300 VDCW	04062	DM15F241J 300V	11	11
0140-0200	C:FXD MICA 390PF 5% 300VDCW	04062	DM15F391J 300V	11	11
0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	04062	DM15E470J	3	3
0140-0205	C:FXD MICA 62PF 5% 300VDCW	04062	DM15E620J 300V	3	3
0140-0217	C:FXD MICA 140PF 2% 300VDCW	28480	0140-0217	5	5
0150-0014	C:FXD CER 5000PF MIN 500VDCW	04222	D1 4	2	2
0150-0021	C:FXD TI 0.47PF 5% 500VDCW	78488	TYPE GA	1	1
0150-0031	C:FXD TI 2PF 5% 500VDCW	78488	TYPE GA 2PF 5%	1	1
0150-0033	C:FXD TI 8.2 PF 10% 500 VDCW	78488	TYPE GA	1	1
0150-0047	C:FXD TI 6.8 PF 10% 500 VDCW	78488	TYPE GA	1	1
0150-0119	C:FXD CER 2X(0.01UF) 20% 250VDCW	56289	41C159A	1	1
0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	56289	56289	17	17
0150-0122	C:FXD CER 2000PF 20% 500VDCW	72982	801 000 Y5S 202M	4	4
0160-0127	C:FXD 1UF 20% 25VDCW	56289	5C13	2	2
0160-0179	C:FXD MICA 33PF 5% 300VDCW	04062	DM15E330J	2	2
0160-0196	C:FXD MICA 24PF 5% 300VDCW	04062	DM15C240J	1	1
0170-0024	C:FXD MY 0.022UF 20% 200VDCW	56289	192P22302	1	1
0170-0072	C:FXD MY 1UF 10% 200VDCW	09134	1042	1	1
0170-0073	C:FXD MY 1UF 10% 600VDCW	09134	1041	1	1
0180-0039	C:FXD ELECT 100UF 12VDCW	56289	30D154A1	1	1
0180-0047	C:FXD ELECT 500UF 75VDCW	56289	D32443	1	1
0180-0049	C:FXD ELECT 20UF 50VDCW	56289	30D198A1	2	2
0180-0050	C:FXD ELECT 40UF -15%+100% 50VDCW	56289	D32536	3	3
0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	56289	TYPE 30D186A1	1	1
0180-0059	C:FXD ELECT 10UF 25VDCW+100-10%	56289	30D106G025 BB4	1	1
0180-0061	C:FXD ELECT 100UF +100%-10% 15VDCW	56289	30D172A1	1	1
0180-0094	C:FXD ELECT 100UF 25VDCW	56289	30D188A1	1	1
0180-0107	C:FXD ELECT 20UF -10/+100% 200VDCW	56289	90803	2	2

See list of abbreviations in introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	TQ
0180-0116	C:FXD ELECT TA 6.8UF 10% 35VDCW	56289	150D685X9035B2	1	1
0180-0124	C:FXD ELECT 200UF 6VDCW	56289	30D137A1	1	1
0340-0038	TERMINAL:STUD	28480	0340-0039	2	1
0340-0039	INSULATOR:TERMINAL POST	00866	HP-3000T-1	1	1
0370-0026	KNOB	28480	0370-0026	1	1
0370-0075	KNOB	28480	0370-0075	1	1
0370-0077	KNOB:	28480	0370-0077	1	1
0683-1015	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015	2	2
0683-1025	R:FXD COMP 1000 OHMS 5% 1/4W	01121	CB 1025	9	9
0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	01121	CB 1035	6	6
0683-1035	R:FXD COMP 10K OHMS 5% 1/4W	01121	CB 1035	63	63
0683-1045	R:FXD COMP 100K OHM 5% 1/4W	01121	CB 1045	25	25
0683-1055	R:FXD COMP 1M OHM 5% 1/4W	01121	CB 1055	7	7
0683-1135	R:FXD COMP 11K OHM 5% 1/4W	01121	CB 1135	1	1
0683-1225	R:FXD COMP 1200 OHMS 5% 1/4W	01121	CB 1225	5	5
0683-1235	R:FXD COMP 12K OHMS 5% 1/4W	01121	CB 1235	2	2
0683-1245	R:FXD COMP 120K OHMS 5% 1/4W	01121	CB 1245	2	2
0683-1255	R:FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255	2	2
0683-1325	R:FXD COMP 1300 OHMS 5% 1/4W	01121	CB 1325	1	1
0683-1525	R:FXD COMP 150 OHMS 5% 1/4W	01121	CB 1525	1	1
0683-1535	R:FXD COMP 15K OHMS 5% 1/4W	01121	CB 1535	2	2
0683-1635	R:FXD COMP 16K OHM 5% 1/4W	01121	CB 1635	12	12
0683-1815	R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815	20	20
0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825	5	5
0683-1835	R:FXD COMP 18K OHMS 5% 1/4W	01121	CB 1835	10	10
0683-2015	R:FXD COMP 200 OHMS 5% 1/4W	01121	CB 2015	24	24
0683-2225	R:FXD COMP 2.2K OHM 5% 1/4W	01121	GB 2225	7	7
0683-2235	R:FXD COMP 22K OHMS 5% 1/4W	01121	CB 2235	13	13
0683-2245	R:FXD COMP 220K OHM 5% 1/4W	01121	CB 2245	1	1
0683-2425	R:FXD COMP 2400 OHMS 5% 1/4W	01121	CB 2425	1	1
0683-2435	R:FXD COMP 24K OHMS 5% 1/4W	01121	CB 2435	3	3
0683-2705	R:FXD COMP 27 OHM 5% 1/4W	01121	CB 2705	5	5
0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725	11	11
0683-2735	R:FXD COMP 27K OHMS 5% 1/4W	01121	CB 2735	7	7
0683-2745	R:FXD COMP 270K OHMS 5% 1/4W	01121	CB 2745	1	0
0683-2745	R:FXD COMP 270K OHMS 5% 1/4W	01121	CB 2745	1	0
0683-2745	R:FXD COMP 270K OHMS 5% 1/4W	01121	CB 2745	5	1
0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025	2	2
0683-3315	R:FXD COMP 330 OHMS 5% 1/4W	01121	CB 3315	2	2
0683-3325	R:FXD COMP 330 OHMS 5% 1/4W	01121	CB 3325	5	5
0683-3335	R:FXD COMP 33K OHMS 5% 1/4W	01121	CB 3335	3	3
0683-3345	R:FXD COMP 330K OHMS 5% 1/4W	01121	CB 3345	1	1
0683-3355	R:FXD COMP 3.3 MEGOHM 5% 1/4W	01121	CB 3355	1	1
0683-3615	R:FXD COMP 360 OHMS 5% 1/4W	01121	CB 3615	1	1

See list of abbreviations in introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	TQ
0683-3915	R:FXD COMP 390 OHMS 5% 1/4W	01121	CB 3915	8	8
0683-3925	R:FXD COMP 3900 OHMS 5% 1/4W	01121	CB 3925	89	89
0683-3935	R:FXD COMP 39K OHMS 5% 1/4W	01121	CB 3935	2	2
0683-3945	R:FXD COMP 390K OHMS 5% 1/4W	01121	CB 3945	24	24
0683-4325	R:FXD COMP 4300 OHMS 5% .25W	01121	CB 4325	1	1
0683-4335	R:FXD COMP 43K OHMS 5% 1/4W	01121	CB 4335	40	40
0683-4705	R:FXD COMP 47 OHMS 5% 1/4W	01121	CB 4705	7	7
0683-4715	R:FXD COMP 470 OHMS 5% 1/4W	01121	CB 4715	1	1
0683-4725	R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725	4	4
0683-4735	R:FXD COMP 47K OHMS 5% 1/4W	01121	CB 4735	121	117
0683-5605	R:FXD COMP 56 OHM 5% 1/4W	01121	CB 5605	4	4
0683-5615	R:FXD COMP 560 OHMS 5% 1/4W	01121	CB 5615	1	1
0683-5625	R:FXD COMP 5600 OHMS 5% 1/4W	01121	CB 5625	1	1
0683-5635	R:FXD COMP 56K OHMS 5% 1/4W	01121	CB 5635	50	50
0683-5645	R:FXD COMP 560K OHMS 5% 1/4W	01121	CB 5645	1	1
0683-6205	R:FXD COMP 62 OHMS 5% 1/4W	01121	CB 6205	5	5
0683-6825	R:FXD COMP 6800 OHMS 5% 1/4W	01121	CB 6825	50	50
0683-6835	R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835	13	13
0683-7505	R:FXD COMP 75 OHM 5% 1/4W	01121	CB 7505	2	2
0683-8215	R:FXD COMP 820 OHMS 5% 1/4W	01121	CB 8215	1	1
0683-8225	R:FXD COMP 8200 OHMS 5% 1/4W	01121	CB 8225	25	25
0683-8235	R:FXD COMP 82K OHMS 5% 1/4W	01121	CB 8235	6	6
0683-8245	R:FXD COMP 820K OHMS 5% 1/4W	01121	CB 8245	1	1
0683-9115	R:FXD COMP 910 OHM 5% 1/4W	01121	CB 9115	2	2
0684-2741	R:FXD COMP 270K OHMS 10% 1/4W	01121	CB 2741	1	1
0686-1525	R:FXD COMP 1500 OHMS 5% 1/2W	01121	EB 1525	1	1
0686-1825	R:FXD COMP 1800 OHM 5% 1/2W	01121	EB 1825	1	1
0686-3625	R:FXD COMP 3600 OHMS 5% 1/2W	01121	EB 3625	1	1
0686-4725	R:FXD COMP 4700 OHMS 5% 1/2W	01121	EB 4725	1	1
0686-4735	R:FXD COMP 47K OHM 5% 1/2W	01121	EB 4735		6
0686-5115	R:FXD COMP 510 OHMS 5% 1/2W	01121	EB 5115	1	1
0686-5625	R:FXD COMP 5600 OHMS 5% 1/2W	01121	EB 5625	3	3
0686-6825	R:FXD COMP 6800 OHMS 5% 1/2W	01121	EB 6825	1	1
0686-7525	R:FXD COMP 7500 OHMS 5% 1/2W	01121	EB 7525	40	40
0686-9115	R:FXD COMP 910 OHMS 5% 1/2W	01121	EB 9115	2	2
0689-1825	R:FXD COMP 1800 OHMS 5% 1W	01121	GB 1825	1	1
0689-2225	R:FXD COMP 2200 OHM 5% 1W	01121	GB 2225	1	1
0689-3625	R:FXD COMP 3600 OHMS 5% 1W	01121	GB 3625	1	1
0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	07115	C 20	8	8

See list of abbreviations in introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	TQ
0758-0024	R:FXD MET FLM 100 OHM 5% 1/2W	07115	C 20	1	1
0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	07115	C 20	8	8
0761-0005	R:FXD 2.2K OHM 5% 1W	07115	C32	2	2
0813-0019	R:FXD 0.47 OHMS 10% 1/2W	75042	BWH	1	1
0816-0020	R:FXD WW 110 OHM 10% 10W	35434	C10110	1	1
0845-0001	NETWORK:RESISTIVE(10 RESISTORS)	28480	0845-0001	6	6
1200-0043	INSULATOR:TRANSISTOR	76530	294457	1	1
1200-0044	SOCKET:TRANSISTOR	97913	M7PB	1	1
1200-0081	INSULATOR:BUSHING NYLON (2)	26365	974	1	1
1205-0025	NUT:HEAT DISSIPATOR	13103	1101A-1	1	1
1205-0026	BODY:HEAT DISSIPATOR	13103	1101A-2(SPL)	1	1
1250-0083	CONNECTOR:BNC	91737	UG-1094/U	1	1
1250-0118	CONNECTOR:BNC	91737	8427	1	1
1251-0087	CONNECTOR:FEMALE 50 PIN MINAT.	02660	5740500	1	1
1251-0135	CONNECTOR:PRINTED CIRCUIT	95354	SD615UR	17	17
1251-0148	CONNECTOR:POWER	60427	H-1061 1G-3L	1	1
1400-0084	FUSEHOLDER EXTRACTOR POST TYPE	75915	342014	1	1
1450-0042	INDICATOR:LIGHT NE2E	03797	18G36980	1	1
1490-0030	STAND:TILT	28480	1490 0030	1	1
1520-0001	MOUNTING PLATE:CAPACITOR	56137	GRADE XP	1	1
1850-0021	TRANSISTOR GERMANIUM 2N2048 PNP	87216	2N2048	1	1
1850-0029	TRANSISTOR GERMANIUM 2N384	28480	1850-0029	6	6
1850-0040	TRANSISTOR GERMANIUM 2N383 PNP	94154	2N383	3	3
1850-0062	TRANSISTOR:SPL2N404A	28480	1850-0062	96	96
1850-0068	TRANSISTOR GERMANIUM 2N1136 PNP	83298	2N1136	1	1
1850-0070	TRANSISTOR:GERMANIUM 2N1373	01295	2N1373	1	1
1850-0091	TRANSISTOR GERMANIUM 2N2048 PNP	87216	2N2048	2	2
1850-0105	TRANSISTOR-GERMANIUM PNP SPL 2N2048	11711	2N2048	16	16
1851-0006	TRANSISTOR 2N169A NPN	03508	2N169A	1	1
1851-0024	TRANSISTOR GERMANIUM 2N388A NPN	0000T	2B388A	1	1
1854-0003	TRANSISTOR NPN SILICON	28480	1854-0003	1	1
1901-0025	SEMICON DEVICE:DIODE JUNCTION	28480	1901-0025	55	55
1901-0028	DIODE SILICON PIV 400V I AVGE 0.75A	28480	1901-0028	8	8
1901-0040	SEMICON DEVICE:DIODE SILICON	28480	1901-0040	2	2
1902-0148	SEMICON DEVICE:DIODE SILICON	28480	1902-0148	1	1
1902-0223	SEMICON DEVICE:DIODE SILICON	28480	1902-0223	1	1
1910-0011	DIODE GERMANIUM SMA AT 1V 60 PIV	28480	1910-0011	13	13
1910-0015	SEMICON DEVICE DIODE GERMANIUM	73293	HD-1409	56	56
1910-0016	SEMICON DEVICE:DIODE GERMANIUM	93332	D2361	11	11
1910-0021	SEMICON DEVICE:DIODE	73293	HPS 1672A	10	10
1970-0002	INDICATOR 10 DIGIT 5532A ONLY	83594	B5022		6
1990-0009	PHOTOCONDUCTOR MULTIPLE 4-10 LINE CONVERS.	28480	1990-0009	6	6
2100-0083	R:VAR COMP 250K OHMS 30% 20CLOG 1/4W	28480	2100-0083	1	1
2100-0128	R:VAR COMP 250 OHMS 20% LIN 1/3W	28480	2100-0128	1	1
2100-0154	R COMP 1000 OHM 30% LIN 3/10W	28480	2100-0154	1	1
2110-0001	FUSE:1 AMP 115 VOLT OPERATION	75915	312001	1	1
2110-0012	FUSE:5AMP 230 VOLT OPERATION	75915	312500	1	1
2110-0033	FUSE:0.75 AMP	75915	F02GR750A	1	1
2140-0022	LAMP GLOW NE-2E NEON	24455	NE 2E	68	8
2140-0044	LAMP:NEON SELECTED MATCHED PAIR	28480	2140-0044	24	24

See list of abbreviations in introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	TQ
3100-0276	SWITCH ROTARY 4 SECT 12 POS	28480	3100-0276	1	1
3100-0277	SWITCH ROTARY 2 SECT 6 POS	28480	3100-0277	1	1
3101-0010	SWITCH PUSHBUTTON DPDT MOM ACTION	82389	3S-1407	1	1
3101-0033	SWITCH:SLIDE DPDT	42190	4633	1	1
3101-0036	SWITCH:TOGGLE SPST	88140	8280K16	1	1
3101-0037	SWITCH:TOGGLE SPST 3 AMP	04009	83050-A	1	1
3101-0038	SWITCH:TOGGLE DPDT 3AMP 125v	04009	83054-B	1	1
3140-0030	MOTOR:FAN 115V 60 CYCLE	28480	3140-0030	1	1
3160-0027	BLADE:FAN 2-1/4 IN DIAM	04870	3160-0027	1	1
5060-0767	FOOT ASSEMBLY	28480	5060-0767	1	1
8120-0078	CABLE POWER SVT-18-3 7.5FT.	70903	KH4147	1	1
9100-0139	TRANSFORMER:POWER	28480	9100-0139	1	1
9140-0029	COIL:RF CHOKE 100UH 2.6 OHMS	98848	3100-15-101	3	3
9140-0115	COIL:FXD 22UH	99800	215032	2	2
5212A-4A	ASSY:DECIMAL COUNTER	28480	5212A-4A	5	
5212A-12A	BRACKET:TRANSFORMER	28480	5212A-12A	1	1
5212A-12B	BRACKET:FAN	28480	5212A-12B	1	1
5212A-41A	INSULATOR:BOTTOM COVER	28480	5212A-41A	1	1
5212A-44A	KIT:RACK MOUNTING	28480	5212A44A	1	1
5212A-47A	SPACER:CAPACITOR	28480	5212A-47A	1	1
5212A-65C	ASSY:DECADE DIVIDER	28480	5212A-65C	6	6
5212A-65D	ASSY:CONTROL GATE	28480	5212A-65D	1	1
5212A-65E	ASSY:DISPLAY CONTROL	28480	5212A-65E	1	1
5212A-65G	ASSY:POWER SUPPLY	28480	5212A-65G	1	1
5212A-85A	ASSY:AIR FILTER	28480	5212A-85A	1	1
5232A-4C	ASSY:DECIMAL COUNTER(5232A ONLY)	28480	5232A-4C	1	
5232A-12A	BRACKET:TERMINAL	28480	5232A-12A	1	1
5232A-65D	ASSY:OSCILLATOR	28480	5232A-65D	1	1
5232A-65E	ASSY:TRIGGER	28480	5232A65E	1	1
5232A-65F	ASSY:AMPLIFIER	28480	5232A65F	1	1
5232A-65H	ASSY:DECADE DIVIDER	28480	5232A-65H	1	1
5232A-69A	ASSY:CRYSTAL	28480	5232A69A	1	1
5512A-4A	ASSY:DECIMAL COUNTER	28480	5212A-4A		5
5532A-4C	ASSY:DECIMAL COUNTER 5532A ONLY	28480	5532A-4C		1
10503A	CABLE ASSEMBLY	28480	10503A	1	1

(a) Model 5232A

(b) Model 5532A

See list of abbreviations in introduction to this section

TABLE 6-3. MANUFACTURER'S CODE LIST

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.	07322	Minnesota Rubber Co.	Minneapolis, Minn.	56289	Sprague Electric Co.	North Adams, Mass.	75915	Littlefuse Inc.	Des Plaines, Ill.
00136	McCoy Electronics	Mount Holly Springs, Pa.	07700	Technical Wire Products	Springfield, N.J.	59446	Telex, Inc.	St. Paul, Minn.	76005	Lord Mfg. Co.	Erie, Pa.
00334	Humidai Co.	Colton, Calif.	07910	Continental Device Corp.	Hawthorne, Calif.	59730	Thomas & Betts Co.	Elizabeth 1, N.J.	76210	C.W. Marwedel	San Francisco, Calif.
00335	Westrex Corp.	New York, N.Y.	07933	Rheem Semiconductor Corp.	Mountain View, Calif.	60741	Tripplett Electrical Inc.	Bluffton, Ohio	76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
00373	Garlock Packing Co.,		07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.	61775	Union Switch and Signal, Div. of		76487	James Millen Mfg. Co., Inc.	Malden, Mass.
	Electronic Products Div.	Camden, N.J.					Westinghouse Air Brake Co.	Swissvale, Pa.	76493	J.W. Miller Co.	Los Angeles, Calif.
00656	Aerovox Corp.	New Bedford, Mass.	07980	Boonton Radio Corp.	Boonton, N.J.	62119	Universal Electric Co.	Owosso, Mich.	76530	Monadnock Mills	San Leandro, Calif.
00779	Amp, Inc.	Harrisburg, Pa.	08145	U.S. Engineering Co.	Los Angeles, Calif.	63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.	76545	Mueller Electric Co.	Cleveland, Ohio.
00781	Aircraft Radio Corp.	Boonton, N.J.	08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada.	64959	Western Electric Co., Inc.	New York, N.Y.	76854	Oak Manufacturing Co.	Crystal Lake, Ill.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.				65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.	77068	Bendix Pacific Division of	
			08717	Sloan Company	Burbank, Calif.	66295	Wittek Manufacturing Co.	Chicago 23, Ill.		Bendix Corp.	No. Hollywood, Calif.
00853	Sangamo Electric Company,		08718	Cannon Electric Co.,Phoenix Div.	Phoenix, Ariz.	66346	Wollensak Optical Co.	Rochester, N.Y.	77075	Pacific Metals Co.	San Francisco, Calif.
	Drill Division (Capacitors)	Marion, Ill.	08792	CBS Electronics Semiconductor Operations,Div. of C.B.S.,Inc.	Lowell, Mass.	70276	Allen Mfg. Co.	Hartford, Conn.	77221	Phaostran Instrument and	
00866	Goe Engineering Co.	Los Angeles, Calif.	08984	Mel-Rain	Indianapolis, Ind.	70309	Allied Control Co., Inc.	New York, N.Y.		Electronic Co.	South Pasadena, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.	09026	Babcock Relays, Inc.	Costa Mesa, Calif.	70319	Allmetal Screw Prod. Co., Inc.	Garden City, N.Y.	77250	Phoeil Mfg. Co.	Chicago, Ill.
01121	Allen Bradley Co.	Milwaukee, Wis.	09134	Texas Capacitor Co.	Houston, Texas				77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
01255	Litton Industries, Inc.	Beverly Hills, Calif.	09250	Electro Assemblies, Inc.	Chicago, Ill.	70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.			
01281	Pacific Semiconductors, Inc.	Culver City, Calif.	09569	Mallory Battery Co. of	Canada, Ltd. Toronto, Ontario, Canada	70563	Amperite Co., Inc.	New York, N.Y.	77342	Potter and Brumfield, Div. of American	
01295	Texas Instruments, Inc.					70903	Belden Mfg. Co.	Chicago, Ill.		Machine and Foundry	Princeton, Ind.
	Transistor Products Div.	Dallas, Texas	09664	The Bristol Co.	Waterbury, Conn.	70998	Bird Electronic Corp.	Cleveland, Ohio	77630	Radio Condenser Co.	Camden, N.J.
01349	The Alliance Mfg. Co.	Indianapolis, Ind.	10214	General Transistor Western Corp.	Los Angeles, Calif.	71002	Birnbach Radio Co.	New York, N.Y.	77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
01561	Chassi-Trak Corp.	Van Nuys, Calif.				71041	Boston Gear Works Div. of	Quincy, Mass.	77764	Resistance Products Co.	Harrisburg, Pa.
01589	Pacific Relays, Inc.	Rockford, Ill.	10411	Ti-Tal, Inc.	Berkeley, Calif.		Murray Co. of Texas	Cleveland, Ohio	78189	Shakeproof Division of Illinois	
01930	Amerock Corp	Santa Clara, Calif.	10646	Carborundum Co.	Niagara Falls, N.Y.	71218	Bud Radio Inc.	Paramus, N.J.		Tool Works	Elgin, Ill.
01961	Pulse Engineering Co.	Saugerties, N.Y.	11236	CTS of Berne, Inc.	Berne, Ind.	71286	Camloc Fastener Corp.		78283	Signal Indicator Corp.	New York, N.Y.
02114	Ferroxcube Corp. of America	Palo Alto, Calif.	11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.	71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.	78290	Struthers-Dunn Inc.	Pitman, N.J.
02286	Cole Mfg. Co.	Chicago, Ill.	11312	Microwave Electronics Corp.	Palo Alto, Calif.	71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.	78452	Thompson-Bremer & Co.	Chicago, Ill.
02660	Amphenol-Borg Electronics Corp.	Somerville, N.J.	11534	Duncan Electronic, Inc.	Santa Ana, Calif.	71436	Chicago Condenser Corp.	Chicago, Ill.	78471	Tilley Mfg. Co.	San Francisco, Calif.
02735	Radio Corp. of America, Semiconductor and Materials Div.		11711	General Instrument Corporation Semiconductor Division	Newark, N.J.	71450	CTS Corp.	Elkhart, Ind.	78488	Stackpole Carbon Co.	St. Marys, Pa.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.	11717	Imperial Electronic, Inc.	Buena Park, Calif.	71468	Cannon Electric Co.	Los Angeles, Calif.	78493	Standard Thomson Corp.	Waltham, Mass.
			11870	Melabs, Inc.	Palo Alto, Calif.	71471	Cinema Engineering Co.	Burbank, Calif.	78553	Tinnerman Products, Inc.	Cleveland, Ohio
02777	Hopkins Engineering Co.	San Fernando, Calif.	12697	Clarostat Mfg. Co.	Dover, N.H.	71482	C.P. Clare & Co.	Chicago, Ill.	78790	Transformer Engineers	Pasadena, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.	12859	Nippon Electric Co., Ltd.	Tokyo, Japan	71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.	78947	Ucinite Co.	Newtonville, Mass.
03705	Apex Machine & Tool Co.	Dayton, Ohio	12930	Delta Semiconductor Inc.	Newport Beach, Calif.				79142	Veeder Root, Inc.	Hartford, Conn.
03797	Eldema Corp.	El Monte, Calif.	13103	Thermolloy	Dallas, Texas	71700	The Cornish Wire Co.	New York, N.Y.	79251	Wenco Mfg. Co.	Chicago, Ill.
03877	Transitron Electronic Corp.	Wakefield, Mass.	14099	Sem-Tech	Newbury Park, Calif.	71744	Chicago Miniature Lamp Works	Chicago, Ill.	79727	Continental-Wirt Electronics Corp.	
03888	Pyrofilm Resistor Co.	Morristown, N.J.	14193	Calif. Resistor Corp.	Santa Monica, Calif.	71753	A.O. Smith Corp., Crowley Div.	West Orange, N.J.			
03954	Air Marine Motors, Inc.	Los Angeles, Calif.	14298	American Components, Inc.	Conshohocken, Pa.	71785	Cinch Mfg. Corp.	Chicago, Ill.	79963	Zierick Mfg. Corp.	Philadelphia, Pa.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.	14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.	71984	Dow Corning Corp.	Midland, Mich.	80031	Mepco Division of Sessions	New Rochelle, N.Y.
			15909	The Daven Co.	Livingston, N.J.	71984	Eitel-McCullough, Inc.	San Bruno, Calif.	80120	Clock Co.	Morristown, N.J.
			16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.	72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.	80130	Schnitzer Alloy Products	Elizabeth, N.J.
04062	Elmenco Products Co.	New York, N.Y.	16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.	71707	Coto Coil Co., Inc.	Providence, R.I.	80130	Times Facsimile Corp.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.	18873	E.I. DuPont and Co., Inc.	Wilmington, Del.	72354	John E. Fast & Co.	Chicago, Ill.	80131	Electronic Industries Association.	Any brand tube meeting EIA standards
04298	Elgin National Watch Co.,		19315	Eclipse Pioneer, Div. of		72619	Dialight Corp.	Brooklyn, N.Y.		Washington, D.C.	
	Electronics Division	Burbank, Calif.		Bendix Aviation Corp.	Teterboro, N.J.	72656	General Ceramics Corp.	Keasbey, N.J.	80207	Unimax Switch, Div. of	
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.	19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.	72699	General Instrument Corp., Semiconductor Div.	Newark, N.J.		W.L. Maxson Corp.	Wallingford, Conn.
						72758	Girard-Hopkins	Oakland, Calif.	80223	United Transformer Corp.	New York, N.Y.
04651	Sylvania Electric Prods., Inc.	Mountain View, Calif.	19701	Electra Manufacturing Co.	Kansas City, Mo.	72765	Drake Mfg. Co.	Chicago, Ill.	80248	Oxford Electric Corp.	Chicago, Ill.
	Electronic Tube Div.		20183	Electronic Tube Corp.	Philadelphia, Pa.	72825	Hugh H. Eby Inc.	Philadelphia, Pa.	80294	Bourns Laboratories, Inc.	Riverside, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona	21226	Executive, Inc.	New York, N.Y.	72928	Gudeman Co.	Chicago, Ill.	80411	Acro Div. of Robertshaw	
			21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.	72964	Robert M. Hadley Co.	Los Angeles, Calif.		Fulton Controls Co.	Columbus 16, Ohio
04732	Filtron Co., Inc., Western Div.	Culver City, Calif.	21335	The Fafnir Bearing Co.	New Britain, Conn.	72982	Erie Resistor Corp.	Erie, Pa.	80486	All Star Products Inc.	Defiance, Ohio
04773	Automatic Electric Co.	Northlake, Ill.	21964	Fed. Telephone and Radio Corp.	Clifton, N.J.	73061	Hansen Mfg. Co., Inc.	Princeton, Ind.	80583	Hammerlund Co., Inc.	New York, N.Y.
04777	Automatic Electric Sales Corp.	Northlake, Ill.	24446	General Electric Co.	Schenectady, N.Y.	73076	H.M. Harper Co.	Chicago, Ill.	80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
04796	Sequavia Wire & Cable Co.	Redwood City, Calif.	24455	G.E., Lamp Division Nela Park,	Cleveland, Ohio	73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.	81030	Magure Industries, Inc.	
04811	Precision Coil Spring Co.	El Monte, Calif.	24655	General Radio Co.	West Concord, Mass.						
04870	P. M. Motor Company	Chicago 44, Ill.	26365	Gries Reproducer Corp.	New Rochelle, N.Y.	73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.	81073	Grayhill Co.	New Haven, Conn.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.	26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.	73445	Amperex Electronic Co., Div. of North American Phillips Co., Inc.	Hicksville, N.Y.	81095	Triad Transformer Corp.	LaGrange, Ill.
			26992	Hamilton Watch Co.	Lancaster, Pa.	73490	Beckman Helipot Corp.	So. Pasadena, Calif.	81312	Winchester Electronics Co., Inc.	Venice, Calif.
05277	Westinghouse Electric Corp.,		28480	Hewlett-Packard Co.	Palo Alto, Calif.	73506	Bradley Semiconductor Corp.	Hamden, Conn.	81349	Military Specification	
	Semi-Conductor Dept.	Youngwood, Pa.	33173	G.E. Receiving Tube Dept.	Owensboro, Ky.	73559	Carling Electric, Inc.	Hartford, Conn.	81415	Wilkor Products, Inc.	Cleveland, Ohio
05347	Ultronix, Inc.	San Mateo, Calif.	35434	Lectrohm Inc.	Chicago, Ill.	73682	George K. Garrett Co., Inc.	Philadelphia, Pa.	81453	Raytheon Mfg. Co., Industrial Components	
05593	Illumintronic Engineering Co.	Sunnyvale, Calif.	36196	Stanwyck Corp.	Hawkesbury, Ontario, Canada	73734	Federal Screw Prod. Co.	Chicago, Ill.		Div., Industr. Tube Operations	Newton, Mass.
05624	Barber Colman Co.	Rockford, Ill.	37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.	73743	Fischer Special Mfg. Co.	Cincinnati, Ohio	81483	International Rectifier Corp.	El Segundo, Calif.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.	39543	Mechanical Industries Prod. Co.	Akron, Ohio	73793	The General Industries Co.	Elyria, Ohio	81541	The Airpax Products Co.	Cambridge, Mass.
			40920	Miniature Precision Bearings, Inc.	Keene, N.H.	73905	Jennings Radio Mfg. Co.	San Jose, Calif.	81860	Barry Controls, Inc.	Watertown, Mass.
05729	Metropolitan Telecommunications Corp.,		42190	Muter Co.	Chicago, Ill.	74276	Signalite Inc.	Neptune, N.J.	82042	Carter Parts Co.	Skokie, Ill.
	Metro Cap. Division	Brooklyn, N.Y.	43990	C.A. Norgren Co.	Englewood, Colo.	74455	J.H. Winns, and Sons	Winchester, Mass.	82142	Jeffers Electronics Division of	
05783	Stewart Engineering Co.	Santa Cruz, Calif.	44655	Ohmite Mfg. Co.	Skokie, Ill.	74861	Industrial Condenser Corp.	Danbury, Conn.		Speer Carbon Co.	Du Bois, Pa.
06004	The Bassick Co.	Bridgeport, Conn.	47904	Polaroid Corp.	Cambridge, Mass.	74868	R.F. Products Division of Amphenol-Borg Electronics Corp.		82170	Allen B. DuMont Labs, Inc.	Clifton, N.J.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.	48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.	74970	E.F. Johnson Co.	Waseca, Minn.	82209	Magure Industries, Inc.	Greenwich, Conn.
06402	E.T.A. Products Co. of America	Chicago, Ill.	49956	Raytheon Company	Lexington, Mass.	75042	International Resistance Co.	Philadelphia, Pa.	82219	Sylvania Electric Prod. Inc.	
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.	50290	Rowan Controller Co.	Baltimore, Md.	75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.		Electronic Tube Div.	Emporium, Pa.
			52900	Ward Leonard Electric	Mt. Vernon, N.Y.	75378	James Knights Co.	Sandwich, Ill.	82376	Astron Co.	East Newark, N.J.
06751	U. S. Semicor Division of Nuclear Corp. of America	Phoenix, Arizona	53429	Shallcross Mfg. Co.	Chicago, Ill.	75382	Kulka Electric Corporation	Mt. Vernon, N.Y.	82389	Switchcraft, Inc.	Chicago, Ill.
			55026	Simpson Electric Co.	Chicago, Ill.	75818	Lenz Electric Mfg. Co.	Chicago, Ill.	82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc.,	
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.	55933	Sonotone Corp.	Elmsford, N.Y.					Spencer Prods.	Attleboro, Mass.
07115	Corning Glass Works		55938	Sorenson & Co., Inc.	So. Norwalk, Conn.				82666	Research Products Corp.	Madison, Wis.
	Electronic Components Dept.	Bradford, Pa.	56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.				82677	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.
07126	Digitran Co.	Pasadena, Calif.							82893	Vector Electronic Co.	Glendale, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.							83053	Western Washer Mfr. Co.	Los Angeles, Calif.
07138	Westinghouse Electric Corp.								83058	Carr Fastener Co.	Cambridge, Mass.
	Electronic Tube Div.	Elmira, N.Y.									
07261	Avnet Corp.	Los Angeles, Calif.									
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.									

TABLE 6-3. MANUFACTURER'S CODE LIST (CONT'D)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.	90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.	95265	National Coil Co.	Sheridan, Wyo.	THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.		
83125	Pyramid Electric Co.	Darlington, S.C.	90970	Bearing Engineering Co.	San Francisco, Calif.	95275	Vitramon, Inc.	Bridgeport, Conn.			
83148	Electro Cords Co.	Los Angeles, Calif.	91260	Connor Spring Mfg. Co.	San Francisco, Calif.	95348	Gordas Corp.	Bloomfield, N.J.			
83186	Victory Engineering Corp.	Union, N.J.	91345	Miller Dial & Nameplate Co.	El Monte, Calif.	95354	Methode Mfg. Co.	Chicago, Ill.			
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.	91418	Radio Materials Co.	Chicago, Ill.	95987	Weckesser Co.	Chicago, Ill.			
83315	Hubbell Corp.	Mundelein, Ill.	91506	Augat Brothers', Inc.	Attleboro, Mass.	96067	Huggins Laboratories	Sunnyvale, Calif.	C0000	JFD Electronics Corp.	Van Nuys, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.	91637	Dale Electronics, Inc.	Columbus, Nebr.	96095	Hr-Q Division of Aerovox	Olean, N.Y.	G0000	Tranex Company	Mountain View, Calif.
83385	Central Screw Co.	Chicago, Ill.	91662	Elco Corp.	Philadelphia, Pa.	96256	Thordarson-Meissner Div. of Magure Industries, Inc.	Mt. Carmel, Ill.	I0000	Western Devices, Inc.	Inglewood, Calif.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.	91737	Greiner Mfg. Co., Inc.	Wakelield, Mass.	96296	Solar Manufacturing Co.	Los Angeles, Calif.	J0000	Winchester Electronics, Inc.	Santa Monica, Calif.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.	91827	K F Development Co.	Redwood City, Calif.	96330	Carlton Screw Co.	Chicago, Ill.	0000F	Malco Tool and Die	Los Angeles, Calif.
83740	Eveready Battery	New York, N.Y.	91929	Minneapolis-Honeywell Regulator Co., Microswitch Div.	Freeport, Ill.	96341	Microwave Associates, Inc.	Burlington, Mass.	0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.	92180	Tru-Connector Corp.	Peabody, Mass.	96501	Excel Transformer Co.	Oakland, Calif.	0000N	Nahm-Bros. Spring Co.	San Leandro, Calif.
83821	Loyd Scruggs Co.	Festus, Mo.	92196	Universal Metal Prod., Inc.	Bassett Puente, Calif.	97464	Industrial Retaining Ring Co.	Irvine, N.J.	0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
84171	Arco Electronics, Inc.	New York, N.Y.	92367	Elgeet Optical Co., Inc.	Rochester, N.Y.	97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.	0000T	Texas Instruments, Inc.	Versailles, Ky.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.	92607	Tinsolite Insulated Wire Co.	Tarrytown, N.Y.	97979	Reon Resistor Corp.	Danvers, Mass.	0000U	Tower Mfg. Corp.	Providence, R.I.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.	93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.	98141	Axel Brothers Inc.	Yonkers, N.Y.	0000W	Webster Electronics Co. Inc.	New York, N.Y.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.	93369	Robbins and Myers, Inc.	New York, N.Y.	98159	Rubber Teck, Inc.	Jamaica, N.Y.	0000X	Spruce Pine Mica Co.	Spruce Pine, N.C.
85454	Boonton Molding Company	Boonton, N.J.	93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio	98220	Francis L. Mosley	Gardena, Calif.	0000Z	Willow Leather Products Corp.	Newark, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.	93788	Howard J. Smith Inc.	Port Monmouth, N.J.	98278	Microdot, Inc.	Pasadena, Calif.	0000A	British Radio Electronics Ltd.	Washington, D.C.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.	93929	G. V. Controls	Livingston, N.J.	98278	Microdot, Inc.	So. Pasadena, Calif.	000AB	ETA	England
85660	Korled Kords, Inc.	New Haven, Conn.	93983	Insuline-Van Norman Ind., Inc.	Manchester, N.H.	98291	Sealectro Corp.	Mamaroneck, N.Y.	000AC	Indiana General Corp., Elect. Div.	Indiana
85674	Midland Mfg. Co. Inc.	Kansas City, Mo.	94137	Electronic Division General Cable Corp.	Bayonne, N.J.	98405	Carad Corp.	Redwood City, Calif.	000AD	Curtis Instrument Inc.	Mt. Kisco, N.Y.
85911	Seamless Rubber Co.	Chicago, Ill.	94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.	98731	General Mills	Minneapolis, Minn.	000BB	Precision Instrument Components Co.	Van Nuys, Calif.
86197	Clifton Precision Products	Clifton Heights, Pa.	94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.	98821	North Hills Electric Co.	Mineola, N.Y.	000CC	Computer Diode Corp.	Lodi, N.J.
86579	Precision Rubber Products Corp.	Dayton, Ohio	94148	Scientific Radio Products, Inc.	Loveland, Colo.	98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.	000EE	A. Williams Manufacturing Co.	San Jose, Calif.
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.	94154	Tung-Sol Electric, Inc.	Newark, N.J.	98978	International Electronic Research Corp.	Burbank, Calif.	000GG	Goshen Die Cutting Service	Goshen, Ind.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.	94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.	99109	Columbia Technical Corp.	New York, N.Y.	000HH	Rubbercraft Corp.	Torrance, Calif.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.	94222	Southco Div. of S. Chester Corp.	Lester, Pa.	99133	Varian Associates	Palo Alto, Calif.	000II	Birtcher Corporation, Industrial Division	Monterey Park, Calif.
87664	Van Waters & Rogers Inc.	Seattle, Wash.	94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.	99515	Marshall Industries, Electron Products Division	Pasadena, Calif.	000KK	Amatol	New Rochelle, N.Y.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.	94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.	99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.	000LL	Avery Label	Monrovia, Calif.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.	95023	Philbrick Researchers, Inc.	Boston, Mass.	99800	Delevan Electronics Corp.	East Aurora, N.Y.	000MM	Rubber Eng. & Development	Hayward, Calif.
88698	General Mills, Inc.	Buffalo, N.Y.	95236	Allies Products Corp.	Miami, Fla.	99848	Wilco Corporation	Indianapolis, Ind.	000NN	A "N" D Manufacturing Co.	San Jose 27, Calif.
89231	Graybar Electric Inc. Co.	Oakland, Calif.	95238	Continental Connector Corp.	Woodside, N.Y.	99934	Renbrandt, Inc.	Boston, Mass.	000PP	Alohm Electronics	Sun Valley, Calif.
89473	General Electric Distributing Corp.	Schenectady, N.Y.	95263	Leecraft Mfg. Co., Inc.	New York, N.Y.	99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.	000QQ	Cooltron	Oakland, Calif.
89636	Carter Parts Div. of Economy Baler Co.	Chicago, Ill.	95264	Lerco Electronics, Inc.	Burbank, Calif.	99957	Technology Instrument Corp of Calif.	Newbury Park, Calif.	000RR	Radio Industries	Des Plaines, Ill.
89665	United Transformer Co.	Chicago, Ill.							000SS	Control of Elgin Watch Co.	Burbank, Calif.
									000WW	California Eastern Lab.	Burlingame, Calif.
									000XX	Methode Electronics, Inc.	Chicago 31, Ill.
									000YY	S.K. Smith Co.	Los Angeles 45, Calif.

APPENDIX I - MANUAL CHANGES

This manual applies directly to the 5232A/5532A Electronic Counters having serial prefix 306. This manual with the following changes also applies to 5232A/5532A Electronic Counters having serial prefix numbers 245, 243, 236, 225, 223, 222, 210, 209, 135.

Instrument Serial No. Prefix	Change No.
243, 245	1
236	1, 2
225	1 thru 3
223	1 thru 4
222	1 thru 5
209, 210	1 thru 6

CHANGE 1

Figure 5-8, Table 6-1:
Substitute Figure IA-1 and Table IA-1

Figure 5-10, Table 6-1:
Substitute Figure IA-2 and Table IA-1

Figure 5-18, Table 6-1:
Substitute Figure IA-3 and Table IA-3

Figure 5-22, Table 6-1:
Change A18Q7 to 2N1672, 1851-0022

Figure 5-25, Table 6-1:
Change Q1 to 2N1123, 1850-0069

CHANGE 2

Figure 5-21: Delete C22 in print command
output between A17 (11) and J4 (23).



CHANGE 3

Figures IA-1 and IA-2:
Change: C1, 2, 15 to 110 pf.
C5 to 39 pf.
C6 to 68 pf.
C9, 11, 12, 14 to 82 pf.
C10, 16 to 150 pf.
R21 to 1000 ohms

Delete: CR20, R61, 62, 63, 64, 65, 66
Add: R25 - 1000 ohms in place of CR20.

CHANGE 4

Figure 5-16:
Change R19 to 1200 ohms

Change all diodes with  Stock No. 1901-0025
to  Stock No. 1901-0031 (affects CR1 through
CR8 on A3 through A8).

CHANGE 5

Figure 5-16:
Change: C4, 7, 8 to 0.1 μ f R8 to 3900 ohms
L1 to 500 μ f R9 to 820 ohms
R2 to 5600 ohms R11 to 6800 ohms
R4 to 5100 ohms R15 to 1000 ohms
R6 to 27K ohms R17 to 47 ohms

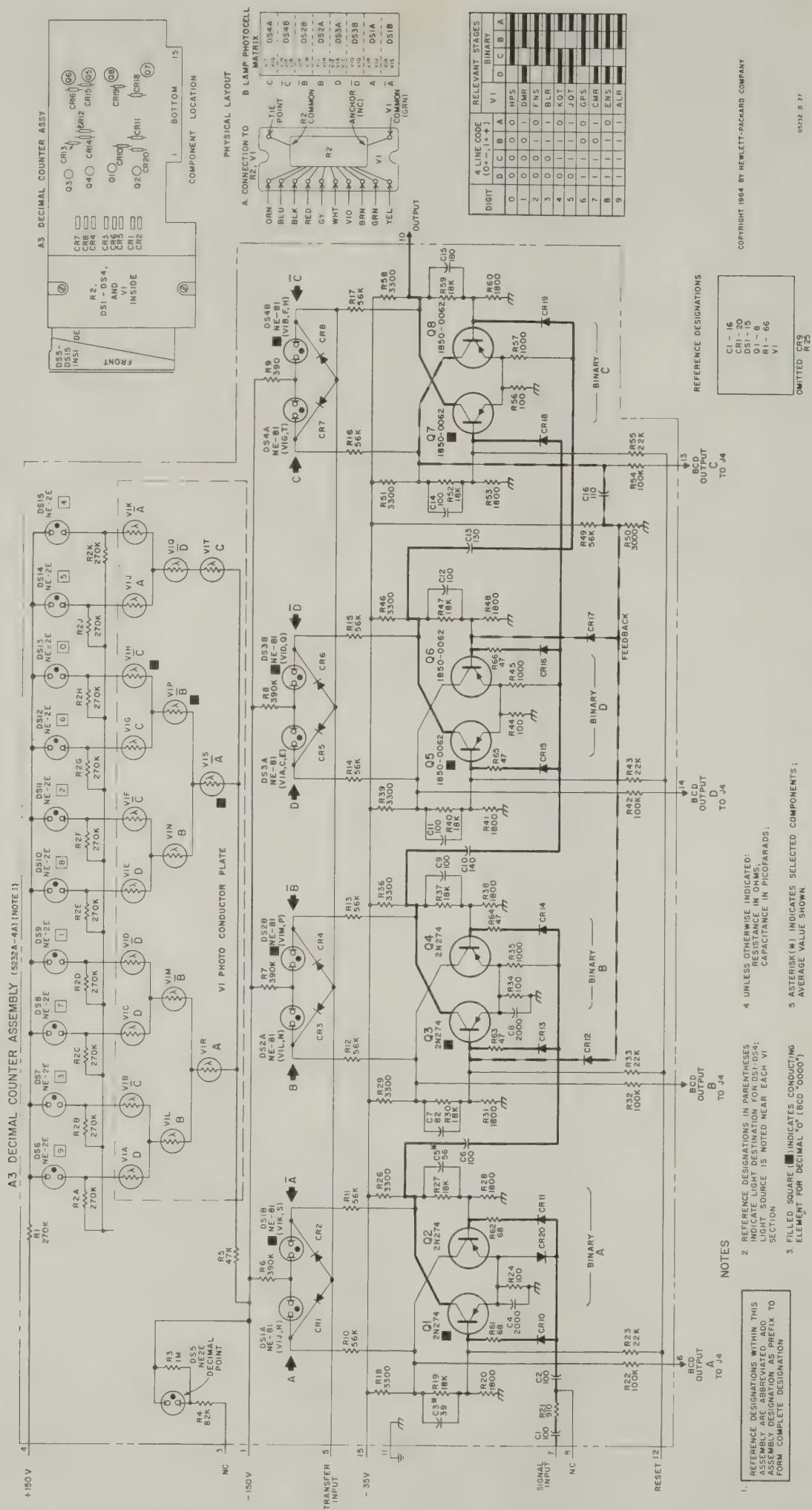
CHANGE 6

Decimal Counter Assemblies A3 thru A8 changed:
Delete connection from DS5 to pin 1.
Add connection from DS5 to pin 2.

Figure 5-6:
Delete CR2 from trigger assembly.

Figure 5-16:
Change: L1 to 200 μ f
R2 to 2700 ohms
R7 to 5600 ohms

Add: R3, 2700 ohms in parallel with L1.



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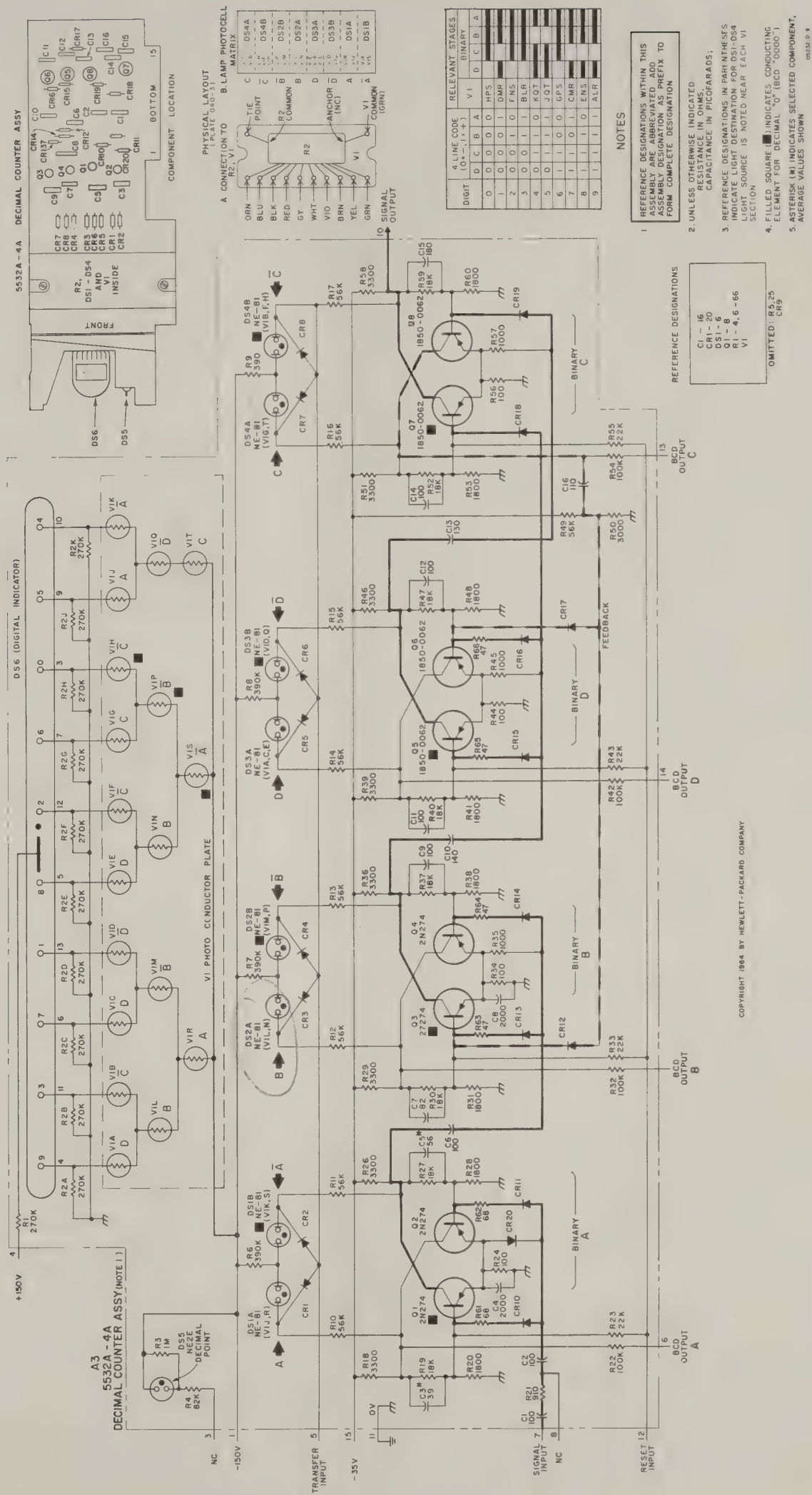


Table IA-1. Reference Designation Index

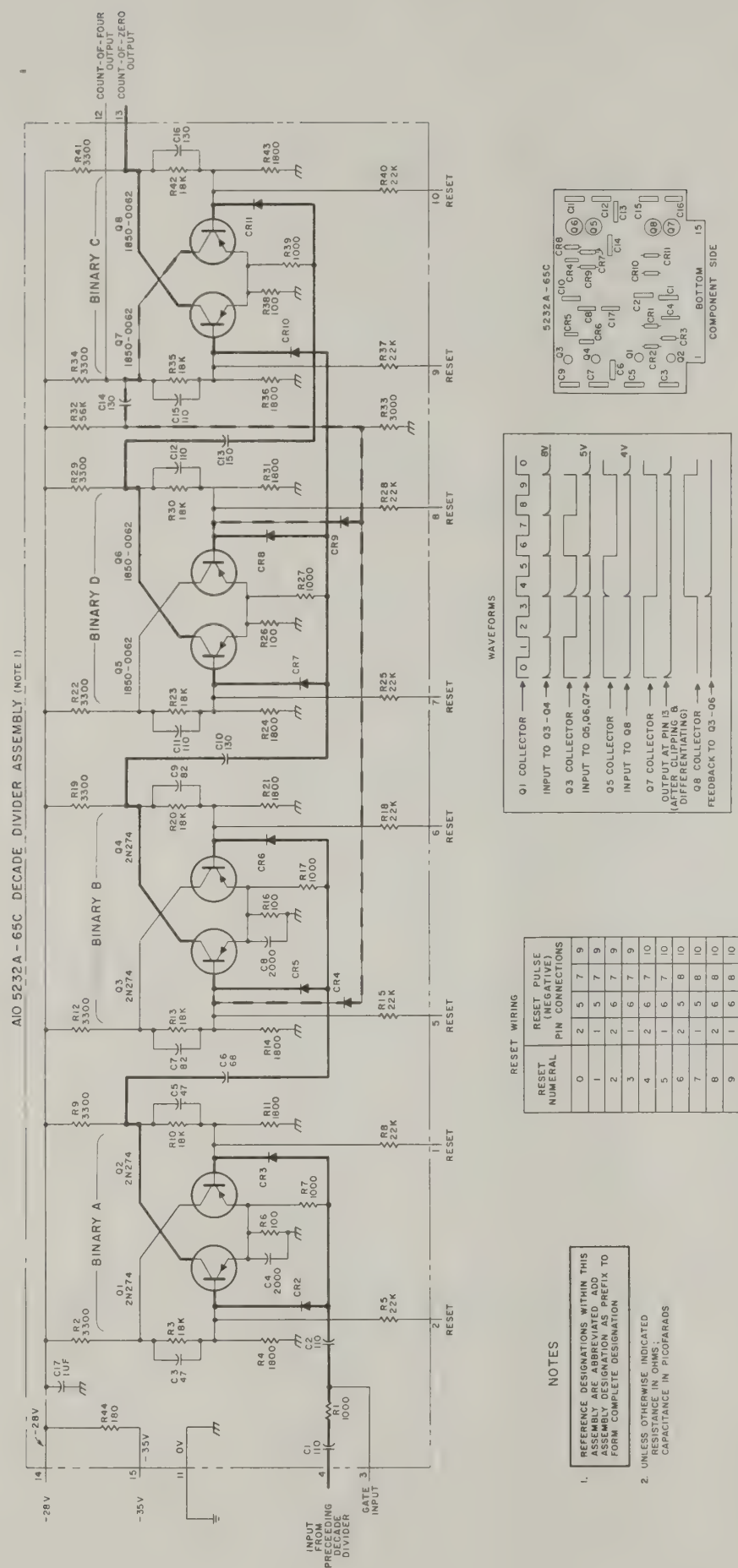
Circuit Reference	Stock No.	Description	Note
A3 A3	5232A-4A 5532A-4A	ASSY:DECIMAL COUNTER FOR 5232A ONLY ASSY:DECIMAL COUNTER FOR 5532A ONLY	
A3C1 A3C2 A3C3	0140-0176 0140-0176 0140-0190	C:FXD MICA 100 PF 2% 300VDCW C:FXD MICA 100 PF 2% 300VDCW C:FXD MICA 39 PF 5% 300VDCW FACTORY SELECTED COMP;TYPICAL VALUE GIVEN	
A3C4 A3C5	0150-0122 0140-0191	C:FXD CER 2000 PF 20% 500VDCW C:FXD MICA 56 PF 5% 300VDCW FACTORY SELECTED COMP;TYPICAL VALUE GIVEN	
A3C6 A3C7 A3C8 A3C9 A3C10	0140-0176 0140-0193 0150-0122 0140-0176 0140-0217	C:FXD MICA 100 PF 2% 300VDCW C:FXD MICA 82 PF 5% 300VDCW C:FXD CER 2000 PF 20% 500VDCW C:FXD MICA 100 PF 2% 300VDCW C:FXD MICA 140 PF 2% 300VDCW	
A3C11 A3C12 A3C13 A3C14 A3C15 A3C16	0140-0176 0140-0176 0140-0195 0140-0176 0140-0147 0140-0194	C:FXD MICA 100 PF 2% 300VDCW C:FXD MICA 100 PF 2% 300VDCW C:FXD MICA 130 PF 5% 300VDCW C:FXD MICA 100 PF 2% 300VDCW C:FXD MICA 180 PF 5% 500VDCW C:FXD MICA 110 PF 5% 300VDCW	
A3CR1 THRU A3CR8 A3CR9 A3CR10 THRU A3CR20	1901-0025 1910-0016	SEMICON DEVICE:DIODE JUNCTION NOT ASSIGNED SEMICON DEVICE:DIODE GERMANIUM	
A3DS1 THRU A3DS15		NOT RECOMMENDED FOR FIELD REPLACEMENT	
A3DS1 THRU A3DS4 A3DS5 A3DS6 A3DS6	5080-0027 2140-0022 2140-0022 1970-0002	LAMP:GLOW,MATCHED PAIRS LAMP:GLOW NE-2E NEON LAMP:GLOW NE-2E NEON 5232A ONLY INDICATOR:10 DIGIT 5532A ONLY	
A3DS7 THRU A3DS15	2140-0022	LAMP:GLOW NEON NE2E	
A3Q1 THRU A3Q4 A3Q5 THRU A3Q8	1850-0105 1850-0062	TRANSISTOR:GERMANIUM PNP SPL 2N2048 TRANSISTOR:GERMANIUM SPL 2N404	
A3R1 A3R1 A3R2 A3R3 A3R4	0683-2745 0686-4735 0845-0001 0683-1055 0683-8235	R:FXD COMP 270K OHM 5% 1/4W(5232A ONLY) R:FXD COMP 47K OHM 5% 1/2W(5532A ONLY) RESISTIVE NETWORK:10 RESISTORS 270K OHM R:FXD COMP 1 MEGOHM 5% 1/4W R:FXD COMP 82K OHM 5% 1/4W	
A3R5 A3R5 A3R6 THRU A3R9 A3R10	0683-4735 0683-3945 0683-5635	R:FXD COMP 47K OHM 5% 1/4W(5232A ONLY) NOT ASSIGNED(5532A ONLY) R:FXD COMP 390K OHM 5% 1/4W R:FXD COMP 56K OHM 5% 1/4W	
A3R11 THRU A3R17	0683-5635	R:FXD COMP 56K OHM 5% 1/4W	

See introduction to this section

Table IA-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description #	Note
A3R18	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A3R19	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R20	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R21	0683-9115	R:FXD COMP 910 OHM 5% 1/4W	
A3R22	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
A3R23	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A3R24	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A3R25		NOT ASSIGNED	
A3R26	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A3R27	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R28	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R29	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A3R30	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R31	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R32	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
A3R33	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A3R34	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A3R35	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A3R36	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A3R37	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R38	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R39	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A3R40	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R41	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R42	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
A3R43	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A3R44	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A3R45	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A3R46	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A3R47	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R48	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R49	0683-5635	R:FXD COMP 56K OHM 5% 1/4W	
A3R50	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	
A3R51	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A3R52	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R53	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R54	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
A3R55	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A3R56	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A3R57	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A3R58	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A3R59	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A3R60	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A3R61	0683-6805	R:FXD COMP 68 OHM 5% 1/4W	
A3R62	0683-6805	R:FXD COMP 68 OHM 5% 1/4W	
A3R63	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
A3R64	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
A3R65	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
A3R66	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
A3V1	1990-0009	PLATE:PHOTOCONDUCTOR NOT RECOMMENDED FOR FIELD REPLACEMENT P/O A3-A8	

See introduction to this section



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Table IA-2. Reference Designation Index

Circuit Reference	Stock No.	Description	Note
A10	5232A-65C	ASSY:DECADE DIVIDER	
A10C1	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
A10C2	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
A10C3	0140-0204	C:FXD MICA 47 PF 5% NPO 500VDCW	
A10C4	0150-0023	C:FXD CER 2000 PF 20% 1000 VDCW	
A10C5	0140-0204	C:FXD MICA 47 PF 5% NPO 500VDCW	
A10C6	0140-0192	C:FXD MICA 68 PF 5% 300VDCW	
A10C7	0140-0193	C:FXD MICA 82 PF 5% 300VDCW	
A10C8	0150-0023	C:FXD CER 2000 PF 20% 1000VDCW	
A10C9	0140-0193	C:FXD MICA 82 PF 5% 300VDCW	
A10C10	0140-0195	C:FXD MICA 130 PF 5% 300VDCW	
A10C11	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
A10C12	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
A10C13	0140-0196	C:FXD MICA 150 PF 5% 300VDCW	
A10C14	0140-0195	C:FXD MICA 130 PF 5% 300VDCW	
A10C15	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
A10C16	0140-0195	C:FXD MICA 130 PF 5% 300VDCW	
A10C17	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A10CR2 THRU A10CR11	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
A10Q1 THRU A10Q4	1850-0037	TRANSISTOR:GERMANIUM PNP 2N274	
A10Q5 THRU A10Q8	1850-0062	TRANSISTOR:GERMANIUM PNP 2N404	
A10R1	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A10R2	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A10R3	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A10R4	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A10R5	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R6	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A10R7	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A10R8	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R9	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A10R10	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A10R11	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A10R12	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A10R13	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A10R14	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A10R15	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R16	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A10R17	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A10R18	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A10R19	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A10R20	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A10R21	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A10R22	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A10R23	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A10R24	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A10R25	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	

See introduction to this section

Table IA-2. Reference Designation Index (cont'd)

Circuit Reference	hp Stock No.	Description	Note
A1OR26	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A1OR27	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A1OR28	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A1OR29	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A1OR30	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A1OR31	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A1OR32	0683-5635	R:FXD COMP 56K OHM 5% 1/4W	
A1OR33	0683-3025	R:FXD COMP 3000 OHM 5% 1/4W	
A1OR34	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A1OR35	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A1OR36	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A1OR37	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A1OR38	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	
A1OR39	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
A1OR40	0683-2235	R:FXD COMP 22K OHM 5% 1/4W	
A1OR41	0758-0010	R:FXD MET FLM 3300 OHM 5% 1/2W	
A1OR42	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
A1OR43	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
A1OR44	0758-0014	R:FXD MET FLM 180 OHM 5% 1/2W	

See introduction to this section

APPENDIX II - OPTION 02

The 5232A/5532A - Option 02 instruments use decimal counters with a 1248 four-line code. Schematics for the 1248 boards used in the Model 5232A/5532A are shown in Figures IIA-1, IIA-2, IIA-3, and IIA-4. Parts lists are given in Tables IIA-1, IIA-2, IIA-3, and IIA-4. A special trigger assembly which has been modified by changing A2Q1 and A2Q2 to type 2N2048 germanium PNP transistors (ϕ Stock No. 1850-0091) has been used in this instrument.

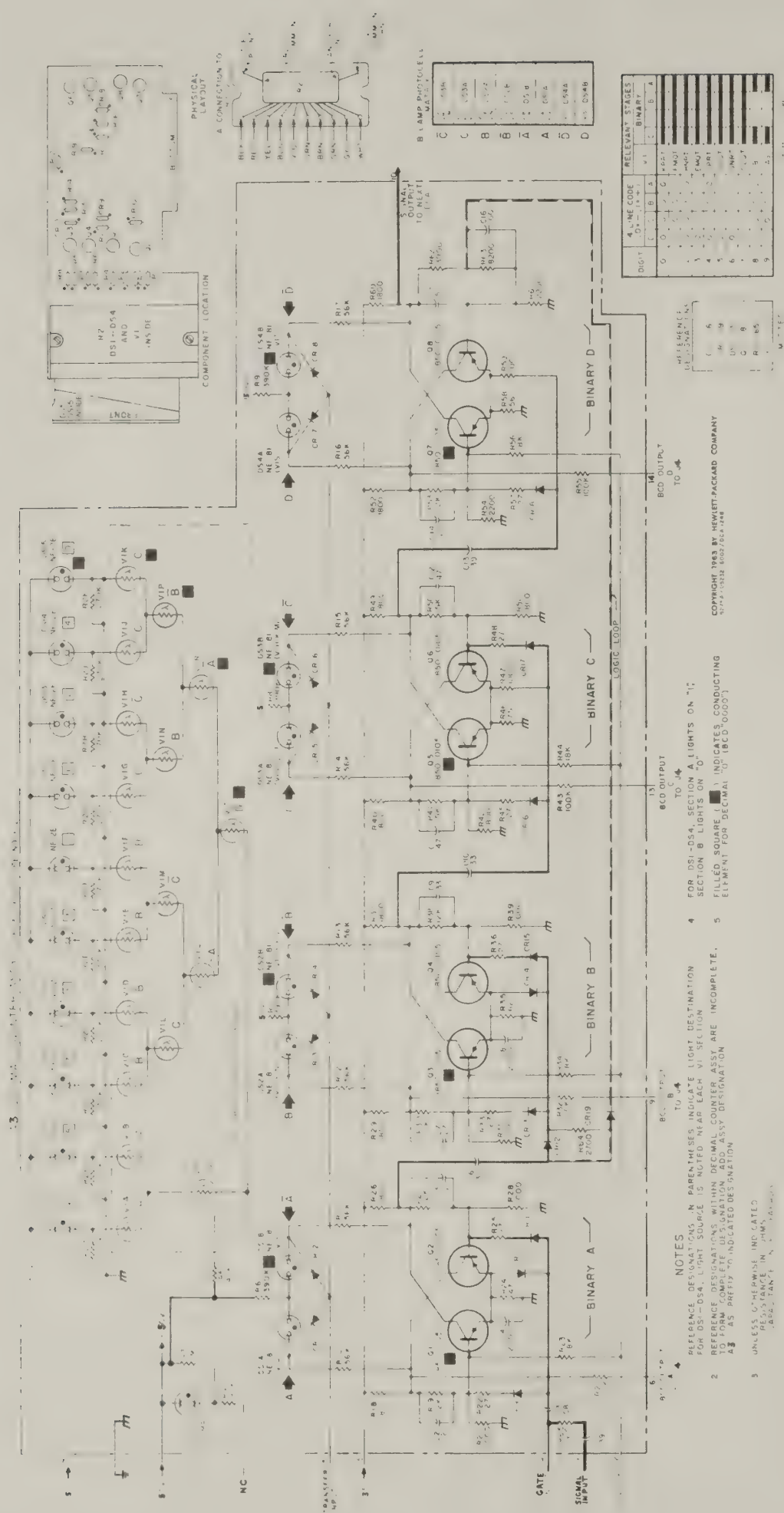


Figure 11A-1

Table IIA-1. Reference Designation Index

Circuit Reference	Stock No.	Description	Note
A3	05232-6001	5 MC DECIMAL COUNTER ASSEMBLY WITH 1-2-4-8 "1" STATE POSITIVE BCD OUTPUT CODE	
C1	0140-0190	C:FXD MICA 39 PF 5% 300VDCW	
C2	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	
C3	0140-0192	C:FXD MICA 68 PF 5% 300VDCW	
C4	0150-0122	C:FXD CER 2000 PF 20% 500VDCW	
C5	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	
C6	0160-0181	C:FXD MICA 30 PF 5% 300VDCW	
C7	0160-0178	C:FXD MICA 27 PF 5% 300VDCW	
C8	0150-0122	C:FXD CER 2000 PF 20% 500VDCW	
C9	0160-0179	C:FXD MICA 33 PF 5% 300VDCW	
C10	0160-0179	C:FXD MICA 33 PF 5% 300VDCW	
C11	0140-0204	C:FXD MICA 47 PF 5% 500VDCW	
C12	0140-0204	C:FXD MICA 47 PF 5% 500VDCW	
C13	0140-0190	C:FXD MICA 39 PF 5% 300VDCW	
C14	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	
C15	0140-0209	C:FXD MICA 5 PF 10% 500VDCW	
C16	0140-0176	C:FXD MICA 100 PF 2% 300VDCW	
CR1 THRU CR8 CR9 CR10 CR11	1901-0025 1910-0021 1901-0040 1910-0021	SEMICON DEVICE:DIODE SILICON SEMICON DEVICE:DIODE GERMANIUM SEMICON DEVICE:DIODE SILICON SEMICON DEVICE:DIODE GERMANIUM	
CR12 CR13 CR14 CR15 THRU CR19	1910-0021 1910-0021 1901-0040 1910-0021	SEMICON DEVICE:DIODE GERMANIUM SEMICON DEVICE:DIODE GERMANIUM SEMICON DEVICE:DIODE SILICON SEMICON DEVICE:DIODE GERMANIUM	
DS1 THRU DS4 DS5 THRU DS15	2140-0044 2140-0022	*LAMP:NEON,GLOW,SELECTED *LAMP:NEON,GLOW,NE2E	
Q1 THRU Q8	1850-0105	TRANSISTOR:GERMANIUM PNP	
R1 R2 R3 R4 R5	0683-2745 0845-0001 0683-1055 0683-8235 0683-4735	R:FXD COMP 270K OHM 5% 1/4W *RESISTIVE NETWORK:10 RESISTORS 270K OHM 20% 1/4W R:FXD COMP 1 MEGOHM 5% 1/4W R:FXD COMP 82K OHM 5% 1/4W R:FXD COMP 47K OHM 5% 1/4W	
R6 THRU R9 R10 THRU R17 R18	0683-3945 0683-5635 0758-0043	R:FXD COMP 390K OHM 5% 1/4W R:FXD COMP 56K OHM 5% 1/4W R:FXD MET FLM 1800 OHM 5% 1/2W	
R19 R20 R21 R22 R23	0683-1235 0683-1025 0683-1045 0683-2705 0683-1835	R:FXD COMP 12K OHM 5% 1/4W R:FXD COMP 1000 OHM 5% 1/4W R:FXD COMP 100K OHM 5% 1/4W R:FXD COMP 27 OHM 5% 1/4W R:FXD COMP 18K OHM 5% 1/4W	

See introduction to this section

Table IIA-1. Reference Designation Index (cont'd)

Circuit Reference	Stock No.	Description	Note
R24	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
R25	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R26	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R27	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R28	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R29	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R30	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R31	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R32	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R33	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R34	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
R35	0683-6205	R:FXD COMP 62 OHM 5% 1/4W	
R36	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R37	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R38	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R39	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R40	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R41	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	
R42	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
R43	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R44	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
R45	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R46	0683-7505	R:FXD COMP 75 OHM 5% 1/4W	
R47	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R48	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R49	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R50	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	
R51	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
R52	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R53	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R54	0683-2225	R:FXD COMP 2200 OHM 5% 1/4W	
R55	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R56	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
R57	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R58	0683-5605	R:FXD COMP 56 OHM 5% 1/4W	
R59	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R60	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R61	0683-2225	R:FXD COMP 2200 OHM 5% 1/4W	
R62	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R63	0683-8225	R:FXD COMP 8200 OHM 5% 1/4W	
R64	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
R65	0683-9115	R:FXD COMP 910 OHM 5% 1/4W	
V1	1990-0018	*PLATE, PHOTOCONDUCTOR	
		*NOT RECOMMENDED FOR FIELD REPLACEMENT	

See introduction to this section

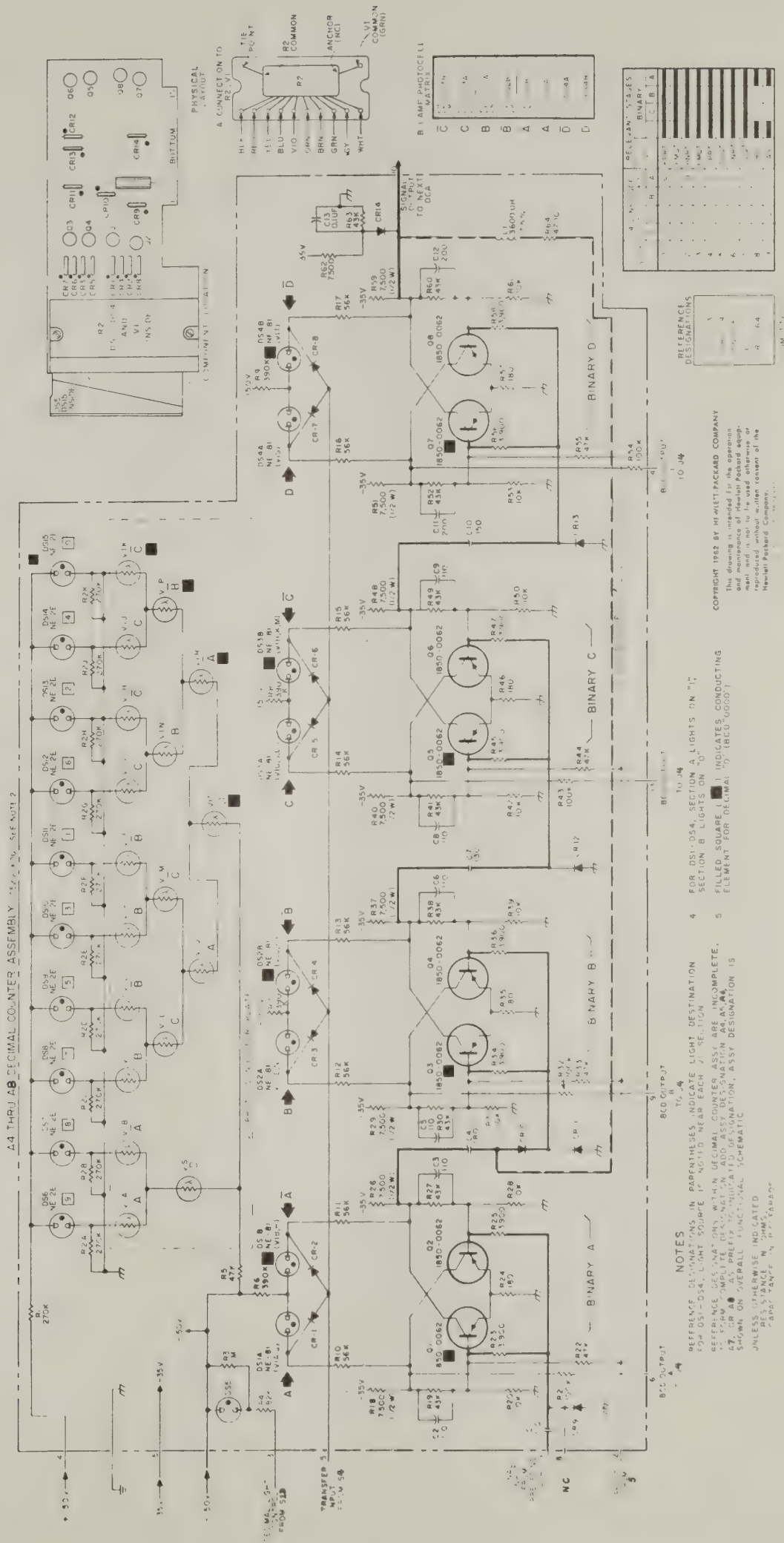


Table IIA-2. Reference Designation Index

Circuit Reference	Stock No.	Description	Note
A4 THRU A8	05212-6001	DECIMAL COUNTER ASSEMBLY WITH 1-2-4-8 "1" STATE POSITIVE BCD OUTPUT CODE	
C1	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C2	0140-0217	C:FXD MICA 140 PF 2% 300VDCW	
C3	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C4	0140-0197	C:FXD MICA 180 PF 5% 300VDCW	
C5	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C6	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C7	0140-0195	C:FXD MICA 130 PF 5% 300VDCW	
C8	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C9	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C10	0140-0196	C:FXD MICA 150 PF 5% 300VDCW	
C11	0140-0198	C:FXD MICA 200 PF 5% 300VDCW	
C12	0140-0198	C:FXD MICA 200 PF 5% 300VDCW	
C13	0150-0121	C:FXD CER 0.1 UF 20% 50VDCW	
CR1 THRU CR8	1901-0025	SEMICON DEVICE:DIODE SILICON	
CR9	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
CR10	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
CR11 THRU CR14	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
DS1 THRU DS4	2140-0044	*LAMP,NE:SELECTED	
DS5 THRU DS15	2140-0022	*LAMP,NE:NE2E	
L1	9140-0161	COIL:FXD 3.6 UH 5%	
Q1 THRU Q8	1850-0062	TRANSISTOR:GERMANIUM	
R1	0683-2745	R:FXD COMP 270K OHM 5% 1/4W	
R2	0845-0001	*RESISTIVE NETWORK:10 RESISTORS 270K OHM 20% 1/4W	
R3	0683-1055	R:FXD COMP 1 MEGOHM 5% 1/4W	
R4	0683-8235	R:FXD COMP 82K OHM 5% 1/4W	
R5	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R6 THRU R9	0683-3945	R:FXD COMP 390K OHM 5% 1/4W	
R10 THRU R17	0683-5635	R:FXD COMP 56K OHM 5% 1/4W	
R18	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R19	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R20	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R21	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R22	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R23	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R24	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
R25	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R26	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R27	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R28	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	

See introduction to this section

Table IIA-2. Reference Designation Index (cont'd)

Circuit Reference	Ⓢ Stock No.	Description	Note
R29	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R30	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R31	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R32	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R33	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R34	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R35	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
R36	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R37	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R38	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R39	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R40	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R41	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R42	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R43	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R44	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R45	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R46	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
R47	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R48	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R49	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R50	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R51	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R52	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R53	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R54	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R55	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R56	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R57	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
R58	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R59	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R60	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R61	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R62	0683-7525	R:FXD COMP 7500 OHM 5% 1/4W	
R63	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R64	0683-4725	R:FXD COMP 4700 OHM 5% 1/4W	
V1	1990-0018	*PLATE:PHOTOCONDUCTOR	
	*	NOT RECOMMENDED FOR FIELD REPLACEMENT	

See introduction to this section



Table IIA-3. Reference Designation Index

Circuit Reference	Stock No.	Description	Note
A3	05532-6001	5 MC DECIMAL COUNTER ASSEMBLY WITH 1-2-4-8 "1" STATE POSITIVE BCD OUTPUT CODE	
C1	0140-0190	C:FXD MICA 39 PF 5% 300VDCW	
C2	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	
C3	0140-0192	C:FXD MICA 68 PF 5% 300VDCW	
C4	0150-0122	C:FXD CER 2000 PF 20% 500VDCW	
C5	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	
C6	0160-0181	C:FXD MICA 30 PF 5% 300VDCW	
C7	0160-0178	C:FXD MICA 27 PF 5% 300VDCW	
C8	0150-0122	C:FXD CER 2000 PF 20% 500VDCW	
C9	0160-0179	C:FXD MICA 33 PF 5% 300VDCW	
C10	0160-0179	C:FXD MICA 33 PF 5% 300VDCW	
C11	0140-0204	C:FXD MICA 47 PF 5% 500VDCW	
C12	0140-0204	C:FXD MICA 47 PF 5% 500VDCW	
C13	0140-0190	C:FXD MICA 39 PF 5% 300VDCW	
C14	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	
C15	0140-0209	C:FXD MICA 5 PF 10% 500VDCW	
C16	0140-0176	C:FXD MICA 100 PF 2% 300VDCW	
CR1 THRU			
CR8	1901-0025	SEMICON DEVICE:DIODE SILICON	
CR9	1910-0021	SEMICON DEVICE:DIODE GERMANIUM	
CR10	1901-0040	SEMICON DEVICE:DIODE SILICON	
CR11	1910-0021	SEMICON DEVICE:DIODE GERMANIUM	
CR12	1910-0021	SEMICON DEVICE:DIODE GERMANIUM	
CR13	1910-0021	SEMICON DEVICE:DIODE GERMANIUM	
CR14	1901-0040	SEMICON DEVICE:DIODE SILICON	
CR15 THRU			
CR19	1910-0021	SEMICON DEVICE:DIODE GERMANIUM	
DS1 THRU			
DS4	5080-0027	*LAMP:NEON GLOW,MATCHED PAIR	
DS5	2140-0022	*LAMP:NE2E	
DS6	1970-0002	DIGITAL DISPLAY INDICATOR	
Q1 THRU			
Q8	1850-0091	TRANSISTOR:GERMANIUM PNP 2N2048	
R1	0686-4735	R:FXD COMP 47K OHM 5% 1/2W	
R2	0845-0001	*R:FXD NETWORK OF TEN,270K OHM 20% 1/4W	
R3	0683-1055	*R:FXD COMP 1 MEGOHM 5% 1/4W	
R4	0683-8235	*R:FXD COMP 82K OHM 5% 1/4W	
R5		NOT ASSIGNED	
R6 THRU			
R9	0683-3945	R:FXD COMP 390K OHM 5% 1/4W	
R10 THRU			
R17	0683-5635	R:FXD COMP 56K OHM 5% 1/4W	
R18	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R19	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R20	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R21	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R22	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R23	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	

See introduction to this section

Table IIA-3. Reference Designation Index (cont'd)

Circuit Reference	Stock No.	Description	Note
R24	0683-4705	R:FXD COMP 47 OHM 5% 1/4W	
R25	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R26	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R27	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R28	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R29	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R30	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R31	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R32	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R33	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R34	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
R35	0683-6205	R:FXD COMP 62 OHM 5% 1/4W	
R36	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R37	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R38	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R39	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R40	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R41	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	
R42	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
R43	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R44	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
R45	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R46	0683-7505	R:FXD COMP 75 OHM 5% 1/4W	
R47	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R48	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R49	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R50	0683-1535	R:FXD COMP 15K OHM 5% 1/4W	
R51	0683-1825	R:FXD COMP 1800 OHM 5% 1/4W	
R52	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R53	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	
R54	0683-2225	R:FXD COMP 2200 OHM 5% 1/4W	
R55	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R56	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	
R57	0683-2705	R:FXD COMP 27 OHM 5% 1/4W	
R58	0683-5605	R:FXD COMP 56 OHM 5% 1/4W	
R59	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	
R60	0758-0043	R:FXD MET FLM 1800 OHM 5% 1/2W	
R61	0683-2225	R:FXD COMP 2200 OHM 5% 1/4W	
R62	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R63	0683-8225	R:FXD COMP 8200 OHM 5% 1/4W	
R64	0683-2725	R:FXD COMP 2700 OHM 5% 1/4W	
R65	0683-9115	R:FXD COMP 910 OHM 5% 1/4W	
V1	1990-0018	*PLATE:PHOTOCONDUCTOR	
		*NOT RECOMMENDED FOR FIELD REPLACEMENT	

See introduction to this section

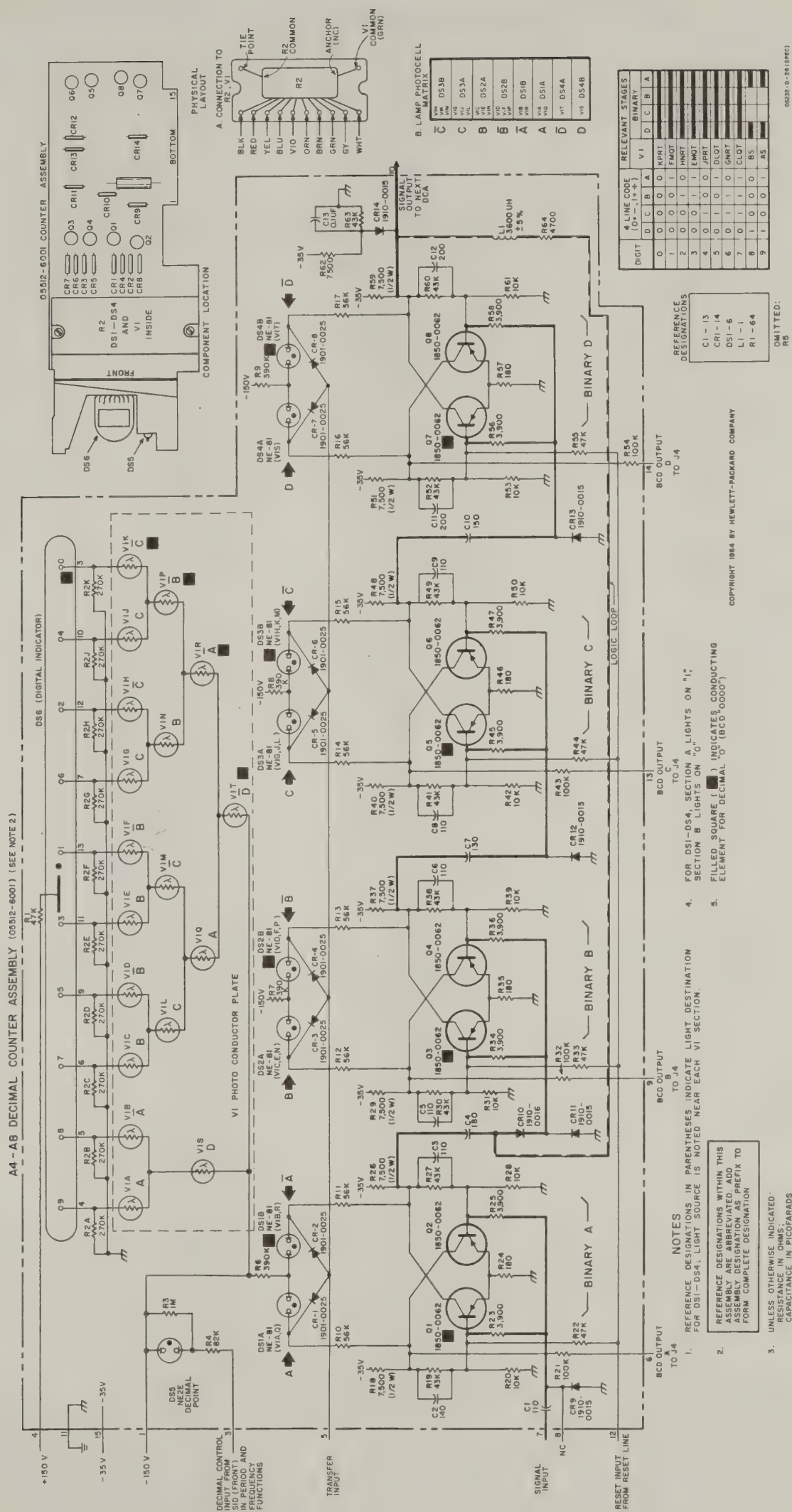


Figure PA-4

Table IIA-4.. Reference Designation Index

Circuit Reference	Stock No.	Description	Note
A4 THRU A8	05512-6001	300 KC DECIMAL COUNTER ASSEMBLY WITH 1-2-4-8 "1" STATE POSITIVE BCD OUTPUT CODE	
C1	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C2	0140-0217	C:FXD MICA 140 PF 5% 300VDCW	
C3	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C4	0140-0197	C:FXD MICA 180 PF 5% 300VDCW	
C5	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C6	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C7	0140-0195	C:FXD MICA 130 PF 5% 300VDCW	
C8	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C9	0140-0194	C:FXD MICA 110 PF 5% 300VDCW	
C10	0140-0196	C:FXD MICA 150 PF 5% 300VDCW	
C11	0140-0198	C:FXD MICA 200 PF 5% 300VDCW	
C12	0140-0198	C:FXD MICA 200 PF 5% 300VDCW	
C13	0150-0121	C:FXD CER 0.1 UF 20% 50VDCW	
CR1 THRU CR8	1901-0025	SEMICON DEVICE:DIODE SILICON	
CR9	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
CR10	1910-0016	SEMICON DEVICE:DIODE GERMANIUM	
CR11 THRU CR14	1910-0015	SEMICON DEVICE:DIODE GERMANIUM	
DS1 THRU DS4	5080-0027	*LAMP,NE:SELECTED,MATCHED PAIR	
DS5	2140-0022	*LAMP,NE:NE2E	
DS6	1970-0002	TUBE,DIGITAL INDICATOR:"NIXIE",10 DIGIT	
L1	9140-0161	COIL:FXD 3.6 UH 5%	
Q1 THRU Q8	1850-0062	TRANSISTOR:GERMANIUM	
R1	0686-4735	R:FXD COMP 47K OHM 5% 1/2W	
R2	0845-0001	*RESISTIVE NETWORK:10 RESISTORS 270K OHM 20% 1/4W	
R3	0683-1055	*R:FXD COMP 1 MEGOHM 5% 1/4W	
R4	0683-8235	*R:FXD COMP 82K OHM 5% 1/4W	
R5		NOT ASSIGNED	
R6 THRU R9	0683-3945	R:FXD COMP 390K OHM 5% 1/4W	
R10 THRU R17	0683-5635	R:FXD COMP 56K OHM 5% 1/4W	
R18	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R19	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R20	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R21	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R22	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R23	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R24	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
R25	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R26	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R27	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R28	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	

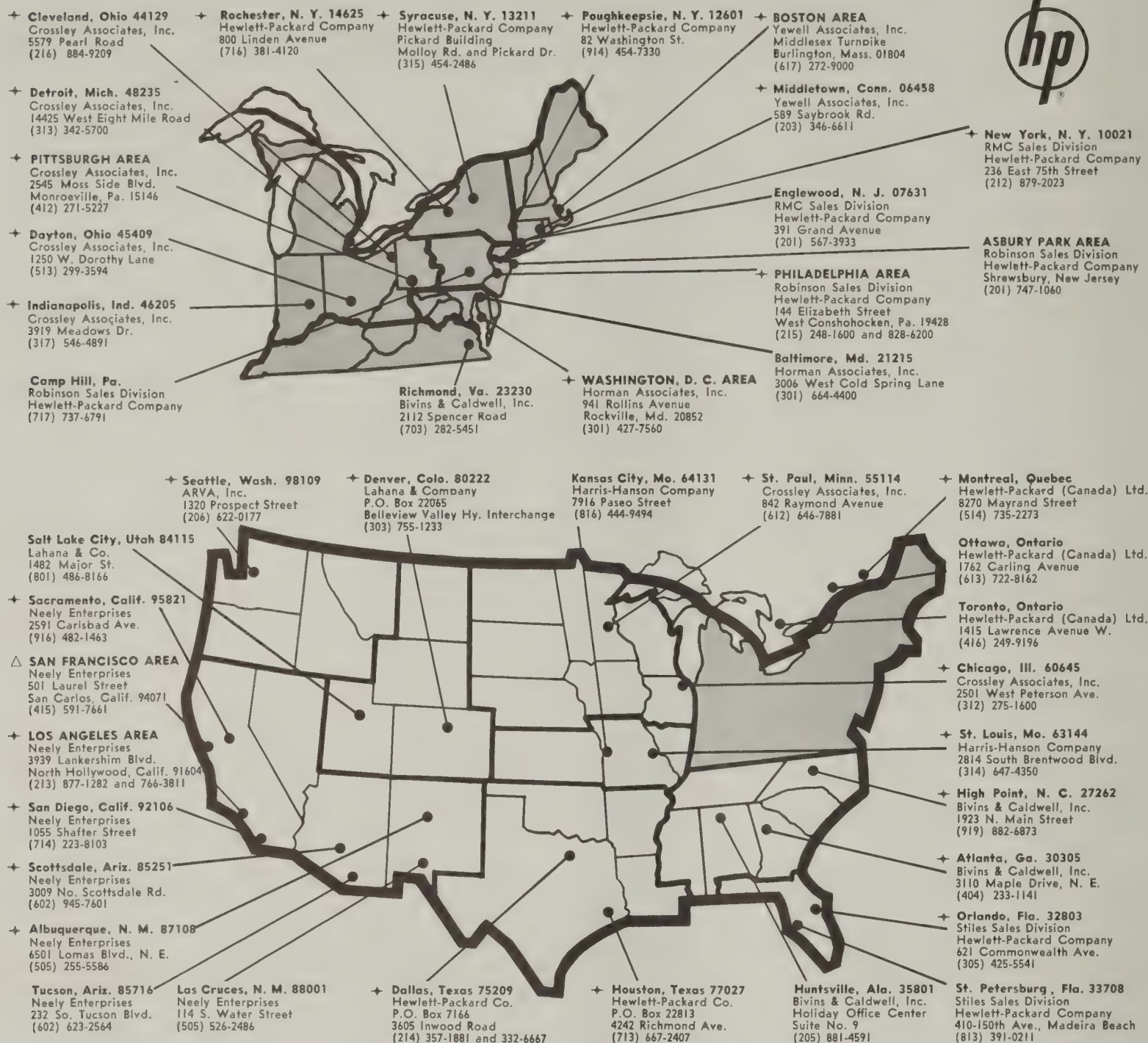
See introduction to this section

Table IIA-4. Reference Designation Index (cont'd)

Circuit Reference	Stock No.	Description	Note
R29	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R30	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R31	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R32	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R33	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R34	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R35	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
R36	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R37	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R38	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R39	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R40	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R41	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R42	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R43	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R44	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R45	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R46	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
R47	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R48	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R49	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R50	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R51	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R52	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R53	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R54	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	
R55	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	
R56	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R57	0683-1815	R:FXD COMP 180 OHM 5% 1/4W	
R58	0683-3925	R:FXD COMP 3900 OHM 5% 1/4W	
R59	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	
R60	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R61	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	
R62	0683-7525	R:FXD COMP 7500 OHM 5% 1/4W	
R63	0683-4335	R:FXD COMP 43K OHM 5% 1/4W	
R64	0683-4725	R:FXD COMP 4700 OHM 5% 1/4W	
V1	1990-0018	*PLATE:PHOTOCONDUCTOR	
		*NOT RECOMMENDED FOR FIELD REPLACEMENT	

See introduction to this section

HEWLETT-PACKARD SALES AND SERVICE OFFICES IN NORTH AMERICA



△ For replacement parts and repair services in the San Francisco area, please contact Hewlett-Packard Company, 395 Page Mill Road, Palo Alto, California, Tel: (415) 326-3950.

→ Indicates Instrument Repair Stations.

HEWLETT-PACKARD COMPANY

1501 Page Mill Road • Palo Alto, California 94304
Tel: (415) 326-7000 • TWX: 415-492-9200 • Cable: HEWPACK

DYMEC DIVISION

395 Page Mill Road • Palo Alto, California 94306
Tel: (415) 326-1755 • TWX: 415-492-9363

BOONTON RADIO COMPANY

Green Pond Road • Rockaway, New Jersey 07866
Tel: (201) 627-6400 • Cable: BOONRACO

HARRISON LABORATORIES

41 Industrial Road • Berkeley Heights, N. J. 07922
Tel: (201) 464-1234 • TWX: Summit, N. J.

SANBORN COMPANY

175 Wyman St., Waltham, Mass. 02154
Tel: (617) 894-6300 • TWX: 617-894-0789

F. L. MOSELEY CO.

409 N. Fair Oaks Ave. • Pasadena, Calif. 91102 • Tel: (213) 681-0208 • TWX: PASA CAL 7687 • Cable: MOCOPAS

AUTHORIZED SALES AND SERVICE OFFICES IN WESTERN EUROPE



HEWLETT-PACKARD S.A.
54 Route des Acacias
Geneva, Switzerland
Telephone: (022) 42.81.50
Telex: 2.24.86
Cable: HEWPACKSA

Sweden
+ H-P Instrument AB
Centralvagen 28
Solna Centrum
Tel: 08-83.08.30

Norway
+ Morgenstjerne & Co.
Wessels Gate 6, Oslo
Tel: 42.99.93

Netherlands
Hewlett-Packard Benelux
+ 23, Burg. Roellstraat, Amsterdam W
Tel: 13 28 98 and 13 54 99

United Kingdom
Hewlett-Packard Ltd.
+ Dallas Road
Bedford, England
Tel: Bedford 68052

Belgium
Hewlett-Packard Benelux
+ 20-24 Rue de l'Hopital, Brussels I
Tel: 11.22.20

France
Hewlett-Packard (France)
+ Boulevard Massena 150
Paris 13e
Tel: 707.97.19

Portugal
TELECTRA
Rua Rodrigo da Fonseca 103
P.O. Box 2531
Lisbon I
Tel: 68 60 72
68 60 73
68 60 74

Spain
ATAIO, Ingenieros
A. Aguilera, No. 8, Madrid 15
Tel: 223.27.42
223.41.71 and 224.84.97

Italy
Dott. Ing. Mario Vianello
+ Via L. Anelli 13, Milan
Tel: 553-081 and 553-811

Via S. Croce in Gerusalemme 97, Rome
Tel: 7.567.250 & 7.567.941

Switzerland
Max Paul Frey
+ Wankdorffeldstrasse 66, Bern
Tel: (031) 42.00.78

Finland
INTO O/Y
P.O. Box 153
11 Meritullinkatu, Helsinki
Tel: 66.39.09 and 35.125

Denmark
Tage Olsen A/S
+ Centrumgården, Room 133
6D, Vesterbrogade, Copenhagen V.
Tel: Minerva 6838

Germany
Hewlett-Packard V.m.b.H.

Steindamm 35, Hamburg
Tel: 24-05-51

+ Kurhessenstrasse 95
6 Frankfurt am Main
Tel: 52.00.36

Reginfriedstrasse 13
8 Munich 9
Tel: 49.51.21

Austria
Hewlett-Packard S.A.
Geneva

Yugoslavia
Belram Electronics
83 Av. des Mimosas
Brussels 15, Belgium
Tel: 35.29.58

Turkey
TELEKOM Engineering Bureau
P.O. Box 376 — Galata
Istanbul
Tel: 49.40.40

Greece
K. Karayannis
Klaffmonos Square, Athens 124
Tel: 230.301 (5 Lines)

Authorized Sales and Service Offices in Other Areas

Argentina
Mauricio A. Suarez
Telecomunicaciones
Carlos Calvo 224, Buenos Aires
Tel: 30-6312

Australia
Sample Electronics Pty. Ltd.
+ 9-11 Cremorne Street
Richmond E. 1, Victoria
Tel: 42-4757 (3 lines)

48 Chippen Street, Sydney
New South Wales
Tel: 69-6338 (6 lines)

India
The Scientific Instrument Company, Ltd.
6, Tej Bahadur Sapru Road, Allahabad I
Tel: 2451

240, Dr. Dadabhai Naoroji Road,
Bombay I
Tel: 26-2642
11, Esplanade East, Calcutta I
Tel: 23-4129

30, Mount Road, Madras 2
Tel: 86339

B-7, Ajmeri Gate Extn., New Delhi I
Tel: 271053

Iran
Telecom Ltd.
P.O. Box 1812, Tehran
Tel: 43850, 48111

Israel
Electronics & Engineering Ltd.
+ 16 Kremenetski St., Tel Aviv
Tel: 35021 (3 lines)

Japan
+ Yokogawa-Hewlett-Packard, Ltd.
2-9, Nakacho, Musashino-shi, Tokyo
Tel: Ogikubo (391) 1901
Musashino (0422)-2 3701

Korea
American Trading Company, Korea, Ltd.
Song Bo Building
112-35 Sokong-Dong, Seoul
Seoul P.O. Box 1103
Seoul
Tel: 3-7049, 3-7613

New Zealand
Sample Electronics (N. Z.) Ltd.
8 Mahipo Street
Onehunga S. E. 5, Auckland
Tel: 565-361

Puerto Rico & Virgin Islands
San Juan Electronics, Inc.
P.O. Box 5167
Pta. de Tierra Sta., San Juan
Tel: 722-3342, 724-4406

South Africa
F. H. Flanzer & Co. (Pty.), Ltd.
Rosella House
Buitencingle Street, Cape Town
Tel: 3-3817

Taiwan (Formosa)
Hwa Sheng Electronic Co., Ltd.
21 Nanking West Road, Taipei
Tel: 4-6076, 4-5936

FOR SALES AND SERVICE ASSISTANCE IN AREAS NOT LISTED CONTACT:

International Marketing Department
Hewlett-Packard Company
+ 1501 Page Mill Road
Palo Alto, California 94304, U.S.A.
Telephone: (415) 326-7000
TWX: 415-492-9200
Telex: 033811
Cable: HEWPACK

+ Indicates Instrument Repair Stations

MARCH 1964



WARRANTY

All our products are warranted against defects in materials and workmanship for one year from the date of shipment. Our obligation is limited to repairing or replacing products (except tubes) which prove to be defective during the warranty period. We are not liable for consequential damages.

For assistance of any kind, including help with instruments under warranty, contact your nearest Hewlett-Packard field office for instructions. Give full details of the difficulty and include the instrument model and serial numbers. Service data or shipping instructions will be promptly sent to you. There will be no charge for repair of instruments under warranty, *except transportation charges*. Estimates of charges for non-warranty or other service work will always be supplied, if requested, before work begins.

CLAIM FOR DAMAGE IN SHIPMENT

Your instrument should be inspected and tested as soon as it is received. The instrument is insured for safe delivery. If the instrument is damaged in any way or fails to operate properly, file a claim with the carrier or, if insured separately, with the insurance company.

SHIPPING

On receipt of shipping instructions, forward the instrument prepaid to the destination indicated. You may use the original shipping carton or any strong container. Wrap the instrument in heavy paper or a plastic bag and surround it with three or four inches of shock-absorbing material to cushion it firmly and prevent movement inside the container.

GENERAL

Your nearest Hewlett-Packard field office is ready to assist you in any situation, and you are always welcome to get directly in touch with Hewlett-Packard service departments:

CUSTOMER SERVICE

Hewlett-Packard Company
395 Page Mill Road
Palo Alto, California, 94306
U.S.A.
Telephone: (415) 326-3950
TWX No. (415) 492-9363
Cable: "HEWPACK"

OR (In Western Europe)

Hewlett-Packard S.A.
54 Route des Acacias
Geneva, Switzerland
Telephone: (022) 42. 81. 50
Cable: "HEWPACKSA"



